Board of Scientific Advice for India

ANNUAL REPORT

FOR THE YEAR

1919-20

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1921

Price One Rupee.

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Lieutenant-Colonel A. T. GAGE, I.M.S.	Director of the Botanical Survey of India and Secretary, Board of Scientific Advice.

List of Sub-Committees.

Sub-Committee A.—(*Meteorology, Terrestrial Magnetism and cognate subjects*).

1. The Surveyor-General of India (Chairman);
2. The Director-General of Observatories;
3. The Director, Geological Survey of India.

Sub-Committee B.—(*Agricultural Products*).

1. The Director, Botanical Survey of India (Chairman);
2. The Inspector-General of Forests;
3. The Agricultural Adviser to the Government of India.

Sub-Committee C.—(*Soils and Manures*).

1. The Agricultural Adviser to the Government of India (Chairman);
2. The Director, Geological Survey of India;
3. The Inspector-General of Forests.

Sub-Committee D.—(*Forest Products*).

1. The Inspector-General of Forests (Chairman);
2. The Agricultural Adviser to the Government of India;
3. The Director, Botanical Survey of India.

Sub-Committee E.—(*Veterinary Subjects*).

1. The Principal, Punjab Veterinary College (Chairman);
2. The Agricultural Adviser to the Government of India;
3. The Director, Zoological Survey of India.

Sub-Committee F.—(*Libraries*).

1. The Director-General of Observatories (Chairman);
2. The Surveyor-General of India;
3. The Director, Geological Survey of India;
4. The Director, Zoological Survey of India.

Annual Report of the Board of Scientific Advice for India, 1919-20.

SUMMARY OF PROCEEDINGS.

Thirty-eighth meeting held at Simla on the 17th May 1920.

The Board considered and accepted the programmes of the various Scientific Departments for 1920-21.

A letter was read and recorded regarding the nomination of Mr. C. C. Calder as Officiating Secretary.

The question of reorganisation of the superior staff of the Zoological Survey of India raised by Dr. Annandale was referred by the Board to a Sub-Committee consisting of the Director-General, Indian Medical Service, the Director, Geological Survey of India, the Director, Zoological Survey of India, the Principal, Punjab Veterinary College, the Agricultural Adviser to the Government of India and the Officiating Director, Botanical Survey of India. This committee was asked to report on the scheme and to submit its report by the 20th May 1920 when the Board would meet to consider it.

A note by the Director, Zoological Survey of India on the question of co-operation and co-ordination between the different Scientific Departments in India was read and recorded.

At an adjourned meeting held on the 20th May 1920 the Board considered the report of the Sub-Committee appointed at their previous sitting. The report was accepted and it was decided that the scheme for reorganisation of the Zoological Survey be recommended to Government for adoption.

Thirty-ninth meeting held at Delhi on the 20th December 1920.

The draft Annual Report was discussed and adopted.

The Board considered a note submitted by the Director-General of Observatories on the utility of their programmes of work and reports. They decided to endorse the standing orders regarding submission of programmes, but as regards the reports the Board were of opinion that the preparation of the bibliography was unnecessary provided that instructions issued to all scientific departments to publish annually, either in their departmental reports or elsewhere, lists of works compiled by officers of the Departments or specially con-r ned with India.

On the question of enlargement of their functions referred to by Dr. Walker the Board considered that they might more usefully perform their functions as a Board of Scientific Advice if they were consulted by the Local Governments on schemes of scientific development or education. In this connection they would welcome the addition to their number of a representative of the Education Department with Scientific qualifications and recommended that the Government of India be asked to nominate such a representative.

The Board further resolved that the Library Sub-committee be asked to inform them at their next meeting as to what has been done regarding the provision of Scientific libraries in India and as to any practical outcome of the recent report on the perishing of paper in India.

APPLIED CHEMISTRY.

PART I.—AGRICULTURAL CHEMISTRY

BY

J. SEN, M.A., PH.D.,

Officiating Imperial Agricultural Chemist.

SOILS.

Soil surveys.—Taylor has nearly completed his survey of soils from a traverse across the centre of south Bhagalpur, and the examination of a similar traverse of the Kosi area in Purneah is almost finished. The Purneah soils appear as a rule to be rich in phosphate, while those in south Bhagalpur seem generally poor in that constituent.

The survey of the Godaveri delta has been finished by Norris. The results indicate a deficiency of phosphoric acid in 25 per cent. of the samples and of nitrogen in 40 per cent. Survey of the Periyar delta is proceeding.

Pillai is carrying out a survey of the soils of the Vaikam taluk in Travancore and the officers of the Indian Tea Association are collecting data connected with the tea soils of North Eastern India.

Soil investigations.—Padmanabha Aiyer, in the course of his examination of the soils of orange gardens of the Central Provinces, has found that the soils of good gardens are rich in lime. The same officer has also examined the chemical and biological aspects of the Bhatta soils of Chandkhuri.

Sahasrabuddhe is continuing his study of the deterioration of the cardamom garden soils in North Kanara.

Tamhane has compared the salt lands of the alluvial tract of Sind with those in the Trap area in South Deccan. He has noticed the remarkable fact that sodium carbonate is not a necessary constituent of black *Kalar*. In the case of some Sind soils, the only salts to which the dark appearance may be attributed are calcium chloride and magnesium chloride. Tamhane's observations on the probable effect of the proposed Sukkur Barrage Scheme are being published soon.

Soil physics.—The problems of the measurements of vapour pressure of the soil water and the determination of the compressibility of the clay contained in soils are engaging the attention of Wilsdon. He is also studying the osmotic equilibrium of salt solutions in soil.

Soil gases.—Harrison has found that the fermentation of green manure under anaerobic conditions does not take an abnormal or unusual course, and

that the absence of carbon dioxide and hydrogen from paddy soil gases is accounted for by a subsidiary bacterial action taking place which results in the reduction of carbon dioxide by the hydrogen and the formation of organic matter and even marsh gas. This reaction between carbon dioxide and hydrogen is beneficial to the paddy crop, ensuring efficiency of root aeration. Mukherji has observed that the percentage of carbon dioxide in soil air is very high in plots over which grass is growing as compared with that in the soil air in cultivated plots. In plots which are grassed down but partially aerated by trenches the air is intermediate in composition. He has also studied the seasonal variation of carbon dioxide in the air of soils thus differently treated.

MANURES AND MANURING.

Green manuring.—Warth is continuing his investigations on the green manuring of paddy soils. He finds that lack of phosphoric acid does not hinder ammonification while it definitely hinders growth of paddy.

Phosphates.—In the way of the utilisation of the mineral phosphates for paddy, promising results have been obtained at Coimbatore by composting them with green manure. Results of experiments so far tried have been negative as to the value of " tetra phosphate."

Harrison has published the results of his investigations on the retention of soluble phosphates in calcareous and non-calcareous soils and has demonstrated that the phosphate manuring of calcareous soils is a very different problem to that of non-calcareous soils.

Potash.—The Indian Tea Association officers are carrying out certain experiments on the fixation of potash by the soil. The heavier acid soils of Assam behave in an abnormal way with regard to absorption of salts.

General.—The manurial requirements of cotton and the availability of organic manures in South Indian soils are being examined by Norris.

CROPS AND FEEDING STUFFS.

Paddy.—Harrison has carried out a series of experiments to compare the effect of ammonium sulphate as a manure on the yield and composition of paddy crops. The employment of ammonium sulphate resulted in a considerable increase in the percentage of nitrogen in the grain.

Pulses.—Clarke is continuing his study of the proteins of the more important Indian pulse crops.

Potatoes.—The chemical changes which accompany the rotting of stored potatoes at high temperatures have been worked out in the Poona laboratory, and the influence of moisture and aeration determined.

Oil seeds.—The oil content of certain selected varieties of castor being investigated by Taylor, and the various oil seeds of Mysore are being examined by Coleman.

Sugarcane.—Investigations in connection with sugarcane and sugar industry were, as usual, carried out by Clarke at Sahajanpur. The results obtained by Harrison as to the effect of windrowing on the composition of canes have been published. The weight of sucrose and crystallisable sugar increases rapidly at first to be followed by a period during which the values remain practically constant, after which deterioration sets in. The period during which canes can be stored varies with different seasons, but in any particular season appears to be determined by the incidence of heavy rain.

Palmyra palm.—Ghosh has drawn attention to the existence in Bihar of a neglected source of sugar in the palmyra palm.

Coconuts.—Norris is continuing his study of the composition of the different parts of the tree at different stages of growth. The chemical changes occurring during the germination of the nut are also under investigation.

Pillai has found in Travancore that the nuts harvested in February and March are found to be of better quality than those harvested in other times.

Sandal.—The separation and identification of some of the organic constituents in healthy and spiked sandal leaves and a study of the influence of various manures on the course of spike are being undertaken in Mysore.

Tea.—From sand culture experiments performed by the officers of the Indian Tea Association it seems that the incidence of Brown Blight of tea is associated with manures of high nitrogen content.

Indigo.—Bhailal Amin has succeeded in developing an easy and productive method of separation of indican from the indigo plant.

Poppy.—Annett is continuing his study of various factors influencing morphine production. The results throw much light upon the function of alkaloids in plant life. It seems that the plant loses the power of producing morphine well before the capsules are ripe. A study of codeine is being taken up on similar lines to that of morphine. The results indicate that the latex has practically a uniform codeine concentration in all parts of the plant, whereas the morphine concentration is highest in the latex in the capsules and diminishes in the lower parts of the plant.

Cyanogenesis.—Some further work has been done by Taylor in connection with the hydrocyanic acid content *jowar* (*Andropogon sorghum*). From these experiments it appears that the atmospheric humidity is a more important factor than soil moisture in deciding the poisonous quality of the young plants.

Warth is continuing his investigations on cyanogenesis in Burma beans (*Phaseolus lunatus*). He has succeeded in isolating some hopeful cultures.

Milk.—Plymen and Aiyer have drawn attention to the variations in the characteristics of the fat of buffalo and cow milk in India, as compared with those noticed in other countries. The departure from the usually accepted

figures is found by them to be greatest during the months when hot dry weather prevails. Annett and Sen have similarly found that the composition of butter fat undergoes a change after the breaking out of rains bringing the usual rush of green grass.

Gangolli and Meldrum have been carrying out an investigation on the production and utilisation of casein in India.

APPLIED CHEMISTRY.

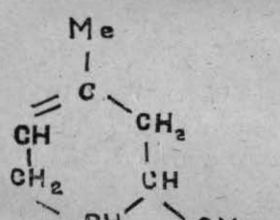
PART II.—FOREST CHEMISTRY

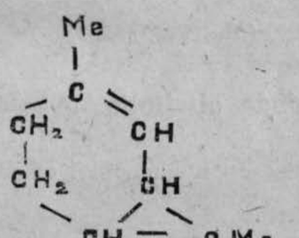
BY

J. L. SIMONSEN,

Forest Chemist, Forest Research Institute, Dehra Dun.

At Dehra Dun a study of the turpentines from the various species of *Pinus* occurring in India has been commenced. The turpentine from *P. longifolia* has been found to consist of l.-α-pinene, β pinene, a new unsaturated bicyclic terpene, to which the name *d-carene* has been given and a tricyclic sesquiterpene *d-longifolene*. *d-carene* is probably represented by one of the two following formulæ :—





The evidence upon which this structure is based will be found in a paper on the subject (Trans. Chem. Soc. 1920. *117*. 570). The inferior quality of Indian turpentine is due to the presence of this terpene which is very readily oxidised.

The turpentine from the oleo-resin of *Pinus Khasya* from Burma has been distilled at Jallo and the oil examined at Dehra Dun. It consists almost solely (about 90 per cent.) of α & β Pinene. It is of some interest that the sesquiterpene present is *d-longifolene* identical with that present in the oil from *P. longifolia*. The turpentine from *P. Khasya* grown in Burma is quite equal in quality to American turpentine and if the collection of the oleo-resin is not too expensive it should prove a formidable competitor. There is some evidence that the turpentine from *P. Khasya* grown in Assam is of inferior quality and it is hoped to examine this oil also.

Camphor and Camphor Oil.—For some years past the leaves from coppiced trees of *Cinnamomum Camphora* grown at the experimental garden at Kaunli have been distilled at Dehra Dun. The results indicate that the leaves yield approximately 4 per cent. of camphor and camphor oil (about 3 per cent. of camphor and 3·7 per cent. of oil). As the oil contains over 30

per cent. of camphor in solution it seems possible that the cultivation of coppiced camphor trees for the extraction of camphor might be of industrial importance. It is hoped this year to complete experiments on the careage yield of leaves and camphor. The oil after the removal of the camphor will probably prove to be of little value, since unlike camphro wood oil, it does not contain any Safrol.

Boswellia serrata.—Dr. Fowler has continued his work on the best methods for the utilisations of the gum-oleo-resin of *Boswellia serrata*. It is understood that the results, which are very promising, will shortly be ready for publication.

Tanstuffs.—Mr. Pilgrim has published an account of his work on the tanstuffs in the Forest at the Rajabhatkhawa Concession granted to the Buxa Timber and Trading Company, Limited, North Bengal. (Report on an Investigation of the Forest Concession of the Buxa Timber and Trading Company, Limited, at Rajabhatkhawa, North Bengal. Government Press 1920.) The results obtained are of undoubted importance but do not lend themselves to summarisation.

Lantana.—At the Indian Institute of Science Mr. J. D. Edal Behram has investigated the Enzymes present in the leaf of *Lantana Camara*. (Journ. Ind. Inst. of Sc. Vol. II, page 195.) The use of the leaves as a tea substitute is suggested.

Morinda citrifolia.—The writer (Trans. Chem. Soc. 1920 *117* 561) shows that the root bark of *Morinda citrifolia* contains in addition to morindone, rubiadin monomethyl ether and alizarine α-methyl ether.

ASTRONOMY

BY

GILBERT T. WALKER, C.S.I., M.A., Sc.D., F.R.S.,

Director-General of Observatories.

Solar physics.—Researches in solar physics are carried on at Kodaikanal under the direction of Mr. J. Evershed. A description of the instruments and of the routine work was given in last year's report. The only change to be noted is the mounting of a 6-inch refractor for general use on the 20-inch equatorial by Grubb received from Poona.

SPECTROSCOPIC RESEARCH.

A continuous series of sunlight and iron arc spectra was obtained in order to test the constancy of the sun-arc displacement. Confining attention to the region 4337-4531 and to lines that are not subject to pole effect in the arc, variations amounting to several thousandths of an angstrom are found in the sun-arc displacement. These variations are of two kinds (1) a general change affecting all the lines in the region studied, and (2) a change affecting particular lines or groups of lines. Whilst measures of the distances between iron lines in the sun and arc spectra show that the variations of the second kind are generally due to a slight instability of the wave-length in the arc there is some evidence that the solar lines are not absolutely stable. It has also been possible to demonstrate the small changes in wave-length in the lines of the iron arc but all efforts to trace the cause of such changes by varying the arc conditions have failed.

In order to test Einstein's prediction of the solar displacement due to the sun's gravitational field, Mr. A. A. Narayana Iyer has measured the displacement of the cyanogen bands near 3883 at the sun's polar limbs. Fifteen plates of limb spectra and carbon arc, and ten plates at the centre of the disc give the following mean displacements of ten prominent triplet bands :—

	in angstroms	in km/sec.
North limb	+0·0061	+0·47
South limb	+0·0083	+0·68
Centre of disc	+ 0·0043	+0·33

These values are, however, much higher than those obtained by St. John for some reason which is not apparent, but they are supported by the follow-

ing values for iron lines which, being free from pole effect and pressure shifts, are considered to be as reliable a test as the cyanogen lines :—

	in angstroms	in km/sec.
North limb	+0·0099	+0·67
South limb	+0·0134	+0·91
Centre of disc	+0·0070	+0·47

The general result is that the displacements are of the same sign and order of magnitude as that predicted by Einstein's hypothesis. The displacement differs, however, with different substances and for different lines of the same substance; moreover, the displacement is not proportional to the wave-length. Hence if the displacements are principally due to a gravitational effect, there must be some unknown modifying influence at work.

The study of the displacements in the Venus spectrum were continued until May 1920. After a considerable period of immunity from drifting of the spectrum during an exposure as a result of the remedies mentioned in the previous report, this trouble reappeared for a time but afterwards disappeared again. It was established that the drift was due to a rotation of the grating, presumably by a motion of the pier on which the grating is mounted caused by climatic changes. The measurements of the Venus spectra are still favourable to the hypothesis of the solar displacements being influenced by the earth, and unfavourable to the Einstein hypothesis.

The evidence with regard to the rotation of Venus commented on in the previous report is inconclusive since the effect observed may be caused, in part at least, by unequal illumination of the slit due to the wandering of the image during an exposure. Owing to this uncertainty, the true rotation period of Venus is still undetermined.

Photographs of sections of the sun's disc have been made in the $H\alpha$ region, and the region studied in the sun and Fe arc plates. It was found that the irregular displacements discovered in 1918 by superposing a reversed positive on a negative of the spectrum may be observed at the centre of the disc, but up to the present they have not been found very near the limb. It appears therefore that, unlike the displacements in the penumbræ of spots, they may be due to movements normal to the surface, or having a component normal to the surface.

A detailed study of the dark markings in $H\alpha$ spectroheliograms has been commenced, chiefly with a view of determining their exact relation to prominences. A preliminary investigation has led to the discovery of the following new features, which are forming the subject of a bulletin now in the press. (1) The average direction of $H\alpha$ dark markings changes from a direction nearly along a meridian in equatorial regions by inclining with the end which is nearer the pole more and more towards the east until in latitudes higher than about 35°, the markings lie nearly along a parallel of latitude. This can be explained as an effect of the polar retardation of the rate of the sun's rotation. (2) Dark

markings when near the limb have almost invariably a bright margin on the side nearest the centre of the sun's disc. The distance of the marking from the centre of the disc when the bright margin on the limb side begins to appear has led to the important conclusion that the dark marking does not generally reach to a level higher than about 10″ above the chromosphere. (3) A narrow absorption strip at the base of prominences in profile at the limb is seen in more than 25 per cent. of the total number of prominences photographed in Hα light and would appear to be typical of the majority of prominences when their base is exactly at the limb. This absorption strip has a width of about 6″ and it is concluded that only up to this height is there sufficient hydrogen in the outer and cooler portions to effect absorption of light from the inner portions of the prominence.

Some experiments have been made regarding the application of interferometer methods to the study of displacements and a new method of using the interferometer which can be applied to study the variation of wave-length across the sun's disc is being made use of.

METEOROLOGY

BY

GILBERT T. WALKER, C.S.I., M.A., Sc.D., F.R.S.,

Director-General of Observatories.

Upper Air.—Work with pilot balloons was continued throughout 1919-20, and at more stations than previously. Lahore had been started in March 1918, and in 1919 three new balloon stations began work at Akyab, Calcutta and Bombay, to provide information for the Air Board. The station at Khojak was closed in January 1919. These new aviation stations will be useful also as an extension of the net-work of scientific balloon stations.

In Agra the results of all stations are tabulated, examined and reduced to the form of half-monthly and monthly resultants. This work was a good deal in arrears, but headway was made towards bringing the results up to date: much still remains to be done.

Normal values of wind direction and velocity at various heights above ground for 5 stations, and about one year's mean resultant values for 4 others, were worked out in Agra. This work is in the press for early publication for the use of the Air Board.

A paper on "Exposure of thermometers in India" was written and is about to be sent to press.

General Meteorology.—Owing to leave arrangements the numbers of the gazetted staff were as low as during the war years, and research was practically at a standstill.

TERRESTRIAL MAGNETISM

BY

GILBERT T. WALKER, C.S.I., M.A., Sc.D., F.R.S.,

Director-General of Observatories.

Magnetic observatories.—Bombay (Alibag).—For a description of the instruments and of the routine work reference should be made to the Annual Report of the Director, Mr. T. K. Chinmayanandam.

Magnetic Survey.—No. 18 Party (Magnetic).—Since the magnetic elements undergo very appreciable changes within a short space of time, it was decided to take observations at the repeat stations at intervals of every five years in order to obtain reliable values of the annual changes; hence the repeat stations, where observations were taken in 1914-15, were visited again in 1919-20. Three detachments were employed in completing the field-season's programme, which comprised observations to determine the declination, dip and horizontal force at the 75 repeat stations in India, Burma and Ceylon, and at 5 new stations which were selected this season and permanently marked, two being in Upper Burma, one in Lower Burma, one in Bengal and one in Assam: these 5 extra stations were much needed for shaping the true course of the lines of annual change in these particular localities. Complete sets of observations were also taken at the Dehra Dun, Toungoo, Kodaikanal and Alibag observatories for the comparison of instruments.

Publication of the results of the Magnetic Survey.—It is regretted that the publication of the results of the magnetic survey from 1901 to 1915 and reduced to the epoch 1909-10, which was promised last year, will not be available before the coming year. Major R. H. Thomas, D.S.O., R.E., Superintendent of the Trigonometrical Survey, who was formerly in charge of the Magnetic Survey, had adjusted the constants used in the computations of the horizontal force before he proceeded to Europe on military duty; he has, on his return to the Department, considered it advisable to revise the constants of all the instruments employed in order to obtain a more accurate determination by utilizing the additional data derived in recent years. It has now, therefore, been decided to compute the results with greater refinement, and, as observations have been taken this season at the repeat stations, to include all the recent observations and bring the publication up to the 1st January 1920.

The reduction of the observations of the detail survey will next be taken in hand and revised. The results of the disturbed areas will then be studied to ascertain whether these areas reveal any prominent magnetic features. It

is doubtful, however, if any definite conclusions will be arrived at, as the results hitherto do not seem to indicate the existence of any centres of attraction. On the contrary, they are very conflicting and appear to show that the disturbances are of a purely local nature, depending entirely upon the unequally magnetized rocks hidden close below the ground surface.

The magnetic elements at observatories.—The computation and tabulation of the provisional values of declination, dip, horizontal force and vertical force for the three observatories (Dehra Dun, Toungoo and Kodaikanal) for the year 1919 have been completed : the mean values of these elements derived from all days, excluding those of great disturbances, are given in the table below :—

Observatory.	Latitude and Longitude.	Dip.	Declination.	H. F.	V. F.
				C.G.S.	C.G.S.
Dehra Dun .	30° 19′ 19″ N 78° 3′ 19″ E	N. 44° 54′ ·8	E. 1° 56′ ·1	·32962	·32863
Toungoo .	18° 55′ 45″ N 96° 27′ 3″ E	N. 23° 8′ ·3	W. 0 20′ ·2	·39097	·16707
Kodaikanal .	10° 13′ 50″ N 77° 27′ 46″ E	N. 4° 33′ ·5	W. 1° 44′ ·5	·37753	·03010

GEOLOGY

BY

E. H. PASCOE, M.A., D.Sc., F.G.S.,
Officiating Director, Geological Survey of India.

Stratigraphy.—In the fossiliferous rocks recently discovered in the hills between Matiana and the Shali peak to the north of Simla nummulites were subsequently obtained, and *Assilina spira* has since been identified. This confirms the age suggested by the *facies* of the rocks, which is that of the Subathu beds of Solan. The sequence from the Shali limestone upwards through the fossiliferous beds to quartzites and slates of the Simla series has the appearance of being a conformable one. There is a considerable amount of disturbance and occasional inversion, and the true geological sequence has not yet been fully established. The matter is one of importance, as it may throw light on the age of the Shali and other similar limestones.

An examination of the Lameta beds of Jubbulpore district was made by Dr. C. A. Matley, who communicated the results to this Department. He divided the formation into five separate zones, and records that the succession from the Jubbulpore series through the Lametas to the Deccan Trap appears to be a conformable one. A number of parallel post-trappean strike faults affecting the Lameta beds were detected by him.

Dr. Matley also discovered in the Lameta beds of Jubbulpore numerous remains of dinosaurs. These include various portions of the skeleton of the great sauropod *Titanosaurus indicus*, Lydekker, and of the carnivorous (theropod) dinosaur allied to *Megalosaurus*.

Geological Surveys.—The survey in the ferriferous belt of Bihar and Orissa was continued, as was also the general systematic survey of the Central Provinces. The systematic survey of Mergui progressed during the year. A reconnaissance survey with the Waziristan Field Force on the north-west frontier, and a similar examination of Mesopotamia, especially with regard to the oilfields of that country, were carried out.

Economic Enquiries.—Investigations were made regarding the following minerals : bauxite in the central parts of the Peninsular area, chromite in the Zhob valley, coal in Tenasserim, iron in the Feudatory States under Bihar and Orissa, petroleum in Mesopotamia, soda in Sind, and sulphur in Baluchistan.

Several sites for dams were examined and reported on during the year, and the question of the water-supply of Quetta was gone into by Mr. Cotter

GEODESY

BY

MAJOR R. H. THOMAS, D.S.O., R.E.,

Officiating Superintendent of the Trigonometrical Survey.

The only Geodetic work done during the year consisted of Tidal Observations and Precise Levelling ; no Triangulation was undertaken nor were any Pendulum or Astronomical Observations made.

LEVELLING OPERATIONS.

1. LEVELLING COMPLETED IN 1919-20.

During the year 1919-20, the following lines of precise levels were run :—

A.—In the Punjab.

(*a*) Ferozepore to Ludhiana (Revision). This line was originally levelled in 1860-62.

(*b*) Amritsar to Ludhiana (New).

(*c*) In the Sind Sagar Doab for the Irrigation Department.

(1) From near Leiah to Shorkot Road Railway station.

(2) From near Khairwala to near Wanbhacharan Railway station.

The total distance levelled in the Punjab including branch lines was about 410 miles, (*a*) and (*b*) on the " Fore and back " and (*c*) on the " Simultaneous " double levelling systems respectively.

B.—In the United Provinces.

Sitapur to Shahjahanpur by the Grand Trunk road. (Revision) The line was originally levelled in 1868-69. The total distance including branch lines was 158 miles and was executed on a slightly modified form of " Fore and back double levelling."

C.—In Assam and Bengal.

Silchar to Comilla *viâ* Karimganj and Akhaura. Including branch lines the total distance was about 197 miles, executed on the old system of Simultaneous double levelling. It was originally levelled in 1911-12 and the revision was undertaken to investigate whether any disturbance of the bench-marks had taken place during the Earthquake of 8th July 1918, the epicentre of which was reported in the Records of the Geological Survey of India, Volume XLIX, Part III, 1918, to be in the Balisera Hills near Kalighat 3½ miles South of Srimangal Railway station. It is to be regretted that the mark-stone of *Charamani H. S.* which was connected by spirit levelling in 1911-12, and the location of which cannot have been a quarter of a mile from the epicentre, was destroyed by the earthquake and the pillar razed to the ground. Thus no comparison of this point was possible. The knoll on which the H. S. stood and the spurs immediately south of it bore deep fissures ziz-zagging down the hill-sides.

The G. T. S. Bench-marks north of and within a quarter of a mile of Srimangal Railway station, which was practically destroyed by the earthquake, show no subsidence, nor is there any evidence of regular disturbance West of Srimangal until the low range of hills 6 miles west of it and lying between Sat-gaon and Rasidpur is crossed. ¾ of a mile north of Rasidpur Railway station, a tree bench-mark at Kamaichara shows practically no alteration ; a mile and a half west of this the settlement of all Bench-marks begins. The settlement varies from 1½ inches to 9 inches according to the nature of the soil and type of bench-mark and continues uninterruptedly past Mirpur Dak Bungalow, Shaistaganj and Shahji Bazar up to a railway bridge 30 miles from Srimangal near Telegraph post No. 149-14 which shows practically no alteration in height (see table below). Thereafter settlement is occasional but very small to Kamalasagar beyond which no appreciable disturbance has taken place. The bench-marks that have settled include two of the embedded type, but unfortunately none on rock, which is situated some distance beneath the alluvial soil.

Comparing results with plate 11 of the Report in the Geological Survey of India Records, as far as can be ascertained no settlement took place in the epicentral area or N.-E. of the epicentral axis, but in the area between the epicentral area and Isoseist No. 2, West South West of the former, settlement up to 9 inches has occurred.

Those bench-marks situated on masonry above ground have generally been disturbed more than those embedded in the soil ; the latter however show distinct settlement.

The following table shows the bench-marks disturbed in the area between Kamaichara and the railway bridge near Telegraph Post No. 149-14 mentioned above.

TABLE III.—REVISION LEVELLING.

Discrepancies between the old and new heights of bench-marks.

Bench-marks of the original levelling that were connected during the revisionary operations.			Distance between bench-mark.	Observed heights, above (+) or below (—) the starting bench-mark.			Difference (Revision—Original). The sign + denotes that the height was greater and the sign (—) less in 1919-20 than when originally levelled.	Remarks.
Number.	Degree Sheet.	Description.		From published heights. Original levelling.	Date of Original levelling.	From revision 1919-20 (Unadjusted).		
			Miles.	Feet	1911-12	Feet	Feet	
35	83D	Embedded bench-mark at Karimganj.	0·0	0·000		0·000		
50	78P	Tree in Kamaichara Village.	77·6	+4·390	,,	+4·336	—0·054*	* In 77·6 miles unaltered.
51	,,	On wing-wall of road bridge.	1·4	—15·008	,,	—15·103	—0·095	
52	,,	On Kerb of well at Mirpur I. B.	1·2	—13·131	,,	—13·263	—0·132	
53	,,	Embedded bench-mark at Mirpur I. B.	0·0	—17·523	,,	—17·705	0·182	
54	,,	On wing-wall of road bridge.	2·4	—14·304	,,	—15·065	—0·761	
55	,,	On wing-wall of road bridge.	1·8	—16·824	,,	—17·360	—0·536	
56	,,	On verandah flooring of Shaistaganj I. B.	0·7	—20·170	,,	—20·469	—0·299	
57	,,	Wing-wall of road bridge	1·7	—24·698	,,	—24·845	—0·147	
58	,,	On Railway Boundary Stone.	2·9	—3·693	,,	—3·806	—0·113	
60	,,	Embedded bench-mark at Shahji Bazar I. B.	0·9	—4·799	,,	—4·991	—0·192	
61	,,	Tree opposite telegraph post No. 152-7.	2·5	—6·067	,,	—6·270	—0·203	
62	,,	On wing-wall of railway bridge.	2·8	—12·835	,,	—12·863	—0·028	Unaltered.

II. SYSTEM OF LEVELLING.

Up to 1913 the system of levelling in use in the Survey of India was that known as "Simultaneous Double Levelling." In that year the system adopted by the International Geodetic Conference of 1912 and known as "Fore and Pack Double Levelling" was adopted.

It has been decided in future to carry out levelling under both systems and to divide the programme into two portions—

(*a*) Geodetic levelling of high precision.

(*b*) Levelling of precision.

(*a*) Will be executed on the" Fore and back " system for the new level net of India, which will intersect and be superimposed on the old adjusted net. A programme for the new net is being made out by which it is hoped to complete the field work in 20 years. In the meanwhile all height values will be adjusted to the old net and published. When the new net is completed, it will be readjusted from its own records independently of the old net, which in turn will be readjusted on to the new net.

(*b*) Levelling of precision on the "Simultaneous double levelling" system. This method will be employed for all work not required for the new net—and will be executed of varying degrees of precision according to the requirements of each line. It will be temporarily adjusted to the present completed net and will afterwards be readjusted to the new net, described in (*a*).

It is hoped by separating the above two systems to include more levelling for other departments in the annual programme.

TIDAL OPERATIONS.

During the past year tidal registrations by means of automatic gauges have been carried out at the following stations :—

Aden, Karachi, Bombay (Apollo Bandar), Bombay (Prince's Dock.), Madras, Kidderpore, Rangoon, Moulmein and Port Blair.

All the tide gauges have worked satisfactorily, and there have been no serious breaks in the tidal registrations.

All the tidal observatories were inspected during the year and the gauges were thoroughly overhauled and put in working order.

In addition to the automatic tidal registrations at the nine stations named above, observations of high and low water on tide poles were taken during day light at Bhaunagar, Chittagong and Akyab, with the object of testing the accuracy of predictions which were based on tidal registrations taken many years ago.

The Director, Inland Water Transport, Basrah, has continued to supply this Department with tidal observations taken on a tide pole at Basrah. On the basis of these observations data for the preparation of tide tables for Basrah for the year 1920 were prepared and supplied to the National Physical Laboratory in England. The predictions were received from the Laboratory in January 1920 and supplied direct to the Director, Inland Water Transport and Port Officer, Basrah, and the Director of the Royal Indian Marine, Bombay, in January 1920.

Data for the preparation of tide tables for Basrah for 1921 were despatched to the Director, National Physical Laboratory in December 1919.

BOTANY.

I.—BOTANICAL SURVEY

BY

C. C. CALDER, B.Sc., B.Sc. (Agr.), F.L.S.,

Officiating Director, Botanical Survey of India.

General.—With the Director and Economic Botanist both absent for a considerable part of the year the work of the Survey had to be restricted to meeting the wishes of collectors throughout India and Burma who depend on the institution at Sibpur for botanical information concerning their local floras. No touring or field work was possible beyond what the writer was able to associate with Cinchona duties. Opportunity was taken to collect materials for a revision of Gamble's list of trees, etc., of the Darjeeling District, particular attention being paid to a checking of the native Lepcha and Nepali names.

Research work of a systematic nature continues, however, to receive the attention of the various botanists, both official and unofficial, whose papers have been noted in former reports. Mr. H. H. Haines has described and arranged the much confused Indian species of Carissa. Mr. Gamble has raised the number of known Indian Mimosas from three to seven with figures and full descriptions of the new species and a useful key to their determination. The synonymy and taxonomic position of *Dioscorea sativa* has been dealt with in an exhaustive manner by Sir David Prain and Mr. I. H. Burkill. Mr. T. A. Sprague has had the genera *Dolichandrone* and *Markhamia* under revision. Prof. Fyson has published a short resumé of a paper on *Eriocaulon* still to appear in the Records while Mr. Sedgwick has contributed several notes and articles to the current botanical literature of the year including an article on his views as to the uses of the term ' variety ' in systematics.

Eastern India.—Dr. Annandale has contributed about 200 specimens from the Chilka lake region. He has under preparation a paper dealing with the biology of the lake and has had the aid of officers of the Survey in the working up of the botanical list which is to form part of the paper.

The most important botanical work dealing with Eastern India has been the examination at Kew of the material collected during the Abor Expedition. These plants have been under examination by Mr. Burkill and other experts at home. Some twenty species new to Science have been described from Abor land. These cover a range of natural families but probably the most important additions are the new *Begonias* described by Mr. Dunn, some of which

may prove to be useful horticultural plants. Mr. R. S. Hole has added a new species of *Ixora* from the Yamethin District of Burma, Mr. C. E. Rogers a new mangrove species—*Brouguiera Hainesii* from Mergui and Dr. Stapf a new Aconite from the Eastern Himalaya.

Northern India.—Prof. Kashyap continues his analysis of the distribution and descriptive morphology of the Himalayan liverworts. The Myxophyceae of Lahore is dealt with by Mr. S. L. Ghose and the flora of Persian Baluchistan and Makran by Blatter and Hallberg. Two new species—*Schefflera bengalensis* and *Rosa Saundersiae*—have been described from Northern India.

Western India.—The Journal of the Asiatic Society contains an interesting paper by Drs. Annandale and Carter on the vegetation of Seistan. The introductory part deals with the vegetation from the Ecological standpoint and the systematic list contains useful notes on the distribution and local names of the species mentioned. An analysis of the flora of the Indian desert of Jodhpur and Jaisalmer is being undertaken by the Rev. E. Blatter and Professor Hallberg. The physiological anatomy of the desert plants of Rajputana—the work of Mr. S. A. Sabnis—is appearing in the new Journal of Indian Botany. The *Alysicarpi* of Western India have been taken up by Mr. Sedgwick.

Southern India.—Mr. Gamble has been able to issue the third part of his flora of the Madras Presidency. The part deals with the flora from Leguminosae-Caesalpinioideae to Caprifoliaceae. The new species are appearing under Decades Kewensis in the Kew Bulletin. Some twenty species new to Science have been described including five new *Oldenlandias* and five *Memecylons* from the Wynaad, Nilgiris and Travancore. Professor Fyson has had some interesting finds of little known plants in the Pulneys. These are species of *Heterocarpus* which have remained practically unknown since Wight's time. The reason for certain variations in the floral coloring of these plants is referred to in a note in the Journal of Indian Botany.

Economic.—The initiation of the scheme for Cinchona Cultivation in Burma has been the most important economic work of the year. The scheme is at present, and must remain for some time, in an experimental stage. So far proof has been obtained that, even under very adverse conditions of climate, the seedling stage of Cinchona can be successfully got over, but the real test for Cinchona in Burma will not come till it is put out to open conditions. Information relative to the rainfall and general weather condition of the Reserve is being accumulated.

BOTANY.

II.—ECONOMIC BOTANY.

Part I.—Agricultural Botany

BY

G. P. HECTOR, M.A., B.Sc.,

Officiating Imperial Economic Botanist.

The present report deals with the progress in Botany as applied to Agriculture during the year ending June 30th, 1920, and as in previous years will deal with the staple crops in order.

Cotton.—The most important work reported during the year is that of Burt, who has completed the survey, examination and selection of the Bundelkhand cottons, and has in preparation a Bulletin dealing with the results, of which the following is a brief summary.

The principal commercial cottons of this tract were collected in 1912 and 1913, grown at Cawnpore, and sorted out, and a number of pure lines isolated and tested for yield, ginning percentage and spinning qualities. The strain finally selected has been widely tested, is an excellent yielder and gins 36 per cent. (as compared to 33 average), while it has a staple of about $\frac{7}{8}$ths of an inch, as compared to $\frac{1}{2}''$ to $\frac{5}{8}''$ for local *Desi*. It is reported by two Cawnpore Mills, who have done spinning trials, to be superior to the best Bundelkhand cottons and to be the best *Desi* cotton they have handled. In 1919 cotton from the 1918 crop spun 18*s* warps and 20*s* weft, as compared to 10*s* from ordinary *Desi*. It was valued in Cawnpore as worth 10 per cent. more than local *Desi* cotton of the best quality. In Bombay it was valued much higher. In 1920 this cotton was reported in Cawnpore to be very good for 16*s* warp even at the worst season of the year, and the general opinion of Cawnpore spinners is that it will find its place on the market on the same basis as several of the finer cottons from Central India now sold as Oomras.

Selection work is now complete and pure seed for 1,000 acres is being distributed this year.

Sugarcane.—Barber (*International Sugar Journal,* November 1919, reprinted in *Agr. Jour. of India,* XV, III, pp. 334-340) has continued his account of the growth of the sugarcane. In a previous article he dealt with the growth of the plants from planting of the seed to the stage when the cane

appears above ground, while in the present he deals with the whole subsequent growth in the cane field.

As reported by Venkatraman, the outstanding feature of the work of the Sugarcane Breeding Station, Coimbatore, during the past season, has been (1) the great number of crossed seedlings raised during the year, a number which has beaten all previous records and (2) the increasing knowledge which the Station is acquiring of work in Northern India. This information is summarised in Pusa Bulletin No. 94. The behaviour of the seedlings distributed to Northern India farms is yielding valuable data as to the lines on which the breeding work should progress in the future. Examination of Coimbatore seedlings has shown that as far as growth is concerned they are satisfactory; and in the future, greater attention than hitherto will be devoted to other characters, such as early maturity and sucrose content. The last batch of seedlings distributed is said to have 1 to 2 per cent. more sucrose in the juice than those of previous years. In Northern India, early maturity is of great importance, as some of the distributions already made, gave comparatively poor results at time of harvest, not because of the poor quality of the seedling, but because of its being unripe at harvest time. This was especially so at Gurdaspur, where Coimbatore seedlings showed an easy increase over local varieties in tonnage.

In the *Agricultural Journal of India* (XV, II, pp. 173-80) Venkatraman gives a useful account of the method of packing seed sugarcane for transport. Kulkarni (*Agr. Jour. of India,* XIV, V, pp. 791-96) gives a further account of experiments and improvements in the method of planting sugarcane, and concludes that the most uniform crop can be obtained by the single eyebud method of planting, with the eyes pointing upwards, and by the removal of tillers.

Rice.—In Bengal, selection work has continued, and a number of strains, both simple selections and strains from crosses, are under observation. Special attention is being paid to the selection of early types for the Western Districts.

In Madras Parnell has continued his work on the lines of previous years. A large number of simple single plant selections from high-yielding strains, together with pure strains derived from crosses, have been tested for yield, and many show a large improvement on local varieties.

In Tanjore a pure strain from a local variety has yielded, consistently for 3 years, 16 per cent. higher than the original farm strain.

Work on inheritance of characters has continued, and the factors determining a large number of characters have been determined and shown to fall into a number of "linkage" groups. In a paper entitled "Experimental Error in Variety Tests with Rice", Parnell calls attention to the large experimental error involved in much of the work published in India, and figures are given, for the combined results of four of the principal crops, showing 13·5 per cent. as the Probable Error of the difference between any two plots.

For ordinary work on rice in Madras about the same figure was obtained, but this was very considerably reduced by using plots of a long narrow shape.

The results of experiments on different methods of conducting variety tests are given and the method adopted on the Paddy Breeding Station at Coimbatore is described. It is shown that the use of strips $50' \times 4'$ reduces the Probable Error of the difference between two to about 6·6 per cent., and that with about 8 to 12 repetitions it should be possible to work to about 2 per cent.

Indigo.—A full account of work done on indigo at Pusa by the Howards has recently been submitted for publication and will shortly be published. According to the Howards wilt is nothing more than the effect of water-logging, and consequent lack of aeration. When there is heavy and continued rainfall, the water-level rises and the soil becomes water-logged, the air supply to the growing roots and nodules of the plants is cut off, and the roots, consequently, cannot thrive. Hence the new roots and nodules begin to die off below and wilt appears above.

Evidence of this has been obtained by growing indigo plants in cemented lysimeters, provided with drainage openings. In cases where the openings were closed all the plants in the lysimeter got wilt, even when growing in soil which was rich in phosphate, and those with free drainage all escaped, even when they were growing in a soil poor in phosphate.

By systematic examination of the roots, it is found that the nodule and new root-formation begin in April, but up to the break of the rains their formation is very slow. Soon afterwards, they begin to grow quickly. When the water-level begins to rise, new roots and nodules are formed towards the surface, and the older, lateral roots begin to change their direction, turning upwards, till by the end of July their tips reach very near the surface of the soil, and almost all new roots and nodules are found in the upper three inches. Weak plants which cannot form new roots in the upper soil, quickly get wilt. In all cases of wilted plants, nodules have been found to be absent and new roots very few.

As a result of Mr. Howard's investigations, five types of root-development have been recorded :

(*a*) Early bush type, with all laterals at right angles and near the surface.

(*b*) Early vertical type, with all laterals near the surface but pointing down.

(*c*) Late bush type, with laterals at right angles, both near the surface and extending to some depth.

(*d*) A similar type to (*c*), but with laterals pointing downwards.

(*e*) No side branches, but tap root only.

Type (*a*) has been found much less subject to wilt than the others, and in the 1919 root examinations, every case of wilt examined was found associated with deep rooting.

It is hoped by a system of mass-selection to produce cultures showing such desirable qualities as earliness, surface-rooting and free branching, and thus to bring the crop back to a type which will thrive in the conditions of Bihar, giving good yields of both seed and leaf, and showing high resistance to wilt.

Opium.—Leake and Annett have published a summary of their work on the production and improvement of Indian Opium (*Agr. Jour. of India, XV, II, March 1920*). This work arose out of the failure of the supply of medical opium with the entry into the war of Turkey and Bulgaria, and its object was to increase the morphine content of Indian opium up to the standard required for medical purposes. The investigation has been both botanical and chemical. Large numbers of samples of seed were procured from all localities where the opium poppy is grown, and pure-line cultures started. Subsequent chemical analysis proved that the racial diversity in morphine content was large, ranging from 6 per cent. in some races to as much as 20 per cent. in others.

Fibres.—In Bengal Finlow and Hector have continued the investigation of chlorosis in jute. The inheritance of the character is being studied and the connection between chlorosis and root-formation is under investigation.

At Cawnpore, Burt reports that experiments with flax, both with imported English seed (Dutchchild) and Japanese seed, have given satisfactory results, confirming previous reports that flax can be profitably grown in the canal tracts of the United Provinces, provided capital will come forward to undertake the financing of the crop and the retting, scutching and marketing.

Fruit.—Robertson Brown has published an interesting paper relating to the effect of various stocks on the orange. (*Bulletin No. 93, Agr. Res. Inst., Pusa, 1920.*) As a result of his experiments he concludes that in North-West India, the "rough lemon," "khatti" or "kharna" gives greatest vigour and fruitfulness to the Malta, while the "sweet lime," "mitha" or "sharbete" is suitable for the Malta in small private gardens only, where a dwarf tree with but few fruits is desired. On the other hand, the "sweet lime" is in almost all respects the best stock for the Sangtara. The stock and scion influence each other profoundly in producing vigour and fruitfulness, and in developing colour, shape, size, quality, flavour, beauty and seedlessness.

The same worker also gives an account of the successful introduction of the European Olive into the North-West Frontier. (*Agr. Jour. of India, XV, II, 150.*) Trials of the Olive at Tarnab have shown that the foreign species grows and bears well and early under irrigation, despite the high temperature and early rainfall. At five years of age, several of the Tarnab trees yielded up to 20 pounds of fruit, and at eight years many are now producing 100 to 120 pounds of good fruit.

In Bombay, Burns has continued his work on fruit, mainly on mangoes, citrus fruits, guavas and plantains. Great progress has been made in bringing

mangoe stock into condition for grafting much earlier than can be done by local methods. The whole of the work on mangoes has been embodied in a book entitled "The Book of the Mangoe" by Dr. Burns and Mr. S. H. Prayag, shortly to appear from the Government Press. In citrus as in mangoe, Burns has been able to reduce the length of time the stock takes to be ready, and the length of time the finished budded plant requires. The drying of the banana has also been most successfully accomplished, a product of excellent colour, taste and keeping qualities being manufactured. An account of this work is given by Burns in the *Agr. Jour. of India, XV, 1820, p.* 166.

Miscellaneous.—Important work on the study and improvement of grass-land is being undertaken in Bombay by Burns. Experimental plots at Ganeshkhind have given excellent results, and the species that prefer different kinds of land are being classified according to these preferences. A new area at Kalas of seven acres of the worst possible Deccan land has been taken up in order to determine whether the grass of such a spot can be improved. Similar studies are in progress at Chharodi, Tegur and Poona.

BOTANY.

II.—ECONOMIC BOTANY.

Part II.—Forest Botany

BY

S. H. HOWARD, B.A.,

Officer-in-charge, Forest Botanist's Office.

1. *Oecology of Sal and Soil-Aeration.*—The results of investigations of past years will appear shortly as a Forest Record. Further investigations are in progress at Dehra Dun. Owing to the poorness of last year's seed crop the work was considerably hampered but this year a better crop was obtained and all necessary sowings have been completed.

2. *Forest Grasses.*—Experiments on the cropping of Ulla grass (*Anthistiria gigantea*) for paper pulp were continued on the previous lines in the Pilibhit division of the United Provinces.

3. *Spike disease of Sandal and Zizyphus.*—Inoculation experiments are being continued in Dehra Dun and investigations continue in Madras and Coorg.

4. *Mycology.*—The root diseases of sal and sissoo, Polyporus Shoreæ and Fomes lucidus are being studied and investigations into the cause of "red-wood" in Spruce have been commenced.

5. *Systematic.*—Large numbers of specimens were received from Forest Officers for identification chiefly in connection with the preparation of descriptive lists and local floras. During the year 131 specimens were identified here. The work has incidentally brought to light species of the following genera which are probably new and descriptions of which will be published when verified—Berberis, Corydalis, Diospyros and Hopea.

6. *Publications.*—During the year the following publications appeared :—

Gupta, B.L.—New Indian Species of Forest importance, Indian Forester, Vol. XLV, pp. 388-392.

Hafiz Khan, A.—Red wood of Himalayan Spruce (Picea Morinda, Link), loc. cit., pp. 496-498.

Hole, R. S.—Note on Hopea canarensis, Indian Forest Record, Vol. VII, Part III.

Hole, R. S.—Note on Ixora Butterwickii, loc. cit., Vol. VII, Part IV.

and the following paper by Mr. R. S. Hole is in the press :—

Note on the Regeneration of Sal Forests.

BOTANY.

II.—ECONOMIC BOTONY.

III.—Mycology

BY

W. McRAE, M.A., B.Sc., F.L.S.,

Officiating Imperial Mycologist, Agricultural Research Institute, Pusa.

The following is an account of the chief investigations at Pusa during the year :—

Black band disease of Jute.—The research work on this disease which is caused by Diplodia Corchori was carried out by Dr. Shaw. In 1919 the state of the Jute crop in Bihar was similar to that in 1918. The attack was light and a considerable portion of the seed crop having been sown late was invariably clean and healthy. Nor was the incidence of the disease in eastern Bengal at all heavy. Observation showed that both the red-stemmed varieties of *Corchorus capsularis* and also Corchorus olitorious were subject to attack though not to the same extent as the common green stemmed variety of the former species and confirmed the fact that only stems of a certain size and maturity are susceptible under ordinary field conditions. Infection experiments on plants in pots and in the field confirmed this. It was also proved that the dissemination of the disease does not take place to any appreciable extent through spores mingled with the jute seed so that steeping the seed before sowing in a solution of copper sulphate is to be discontinued.

Diseases of temperate fruits.—Work on these was done in Kumaon and Peshawar. The apple mildew (Podosphaera) spraying series included a test of home-made lime sulphur, Berger's lime sulphur and Burgundy mixture, lead arsenate being added in each case. The trees stood even the " winter " strength of lime sulphur successfully and the experiments showed that an application of this fungicide made at the proper time will largely control the disease. Berger's mixture proved very satisfactory and simple to use. Further experiments with iron sulphide are, however, required before deciding on lime sulphur as the routine treatment. For the branch blister and apple cracking disease (Coniothecium chromatosporum) the same three sprays were used with good effect for two of them but Burgundy mixture caused so much damage to fruit and leaves as to be largely a failure. This is in conformity with recent work with this mixture in English orchards. There was little of

the fly speck and sooty blotch disease (Leptothyrium Pomi) present but the trees sprayed with lime sulphur and Burgundy mixture had certainly less than the others and injury from the latter spray was again marked. Peach leaf curl was entirely controlled by all three sprays.

Potato storage rots.—A series of experiments was conducted at Sialkot in collaboration with the Punjab Department of Agriculture. In storing potato tubers a two-storeyed well ventilated house was selected and fumigated with sulphur vapour. Two sorts of tubers were selected (*a*) from fields where potatoes were grown as ordinary routine crop (*b*) from fields where potatoes were grown for the first time. The selected potato tubers were then put into sterile gunny sacks and fumigated with petrol vapour for 24 hours. Some of these fumigated potatoes were stored (1) in dry sand (2) sacks, loosely packed (3) on racks made of wooden battens. The rest of the fumigated potatoes were treated in corrosive sublimate solution (1 in 2,000) for 1 hour and afterwards taken out and dried and were stored exactly in the above manner. The experiment lasted during May and June, 1919. The year being exceptionally trying on account of the excessive heat, potatoes started rotting very soon and in every case the bulk of the potatoes became rotten. These results bear out the conclusion previously come to that the rot is primarily a result of excessive temperature.

Root rot on cotton.—On a visit to Lyallpur Dr. Butler came to the conclusion that the root rot of cotton which occurs sporadically through most of northern and western India, is a non-parasitic one which is associated with some unknown soil condition.

Cereal diseases.—Species of Helminthosporium were found commonly attacking maize, jowar, bajra, rice, wheat, oats, barley and sugarcane. In every case the chief attack is on the leaves, and excepting the stripe disease of barley the symptoms are on the whole very similar. The parasite concerned was isolated from each of the above hosts and grown in pure culture for comparative study. Wheat was found to have a considerable range of forms on it in different parts of India. They appear to be related to *H. teres* Sacc. On rice the common species appears to be *H. Oryzae* Hori, previously described from Japan. *H. turcicum* Pass. occurs on maize and jowar but freely grows also on wheat, oats, barley and sugarcane. It does not attack bajra and only rarely attacks rice. The species on sugarcane and rice attack all the hosts on which they have been tried whereas the wheat and barley species give reciprocal successful results. An allied genus, *Acrothecium*, is parasitic on several of the *Gramineae* and one species attacks bajra at Pusa somewhat severely. It is a new species, which has been named *Acrothecium Penniseti*. The attack is on leaves, leaf sheaths and ears, the leaf form being the commonest but the ear attack probably doing most damage. The spikelets are attacked in clusters and the grain aborted. It is a vigorous parasite and can attack maize ears but not leaves, while jowar is immune. A second species, *Acrothecium lunatum* Wakker, is common at Pusa on maize and jowar, as well

as on several wild grasses. It appears to do a good deal of injury to the male inflorescence of the former, where it is sometimes associated with *Acrothecium falcatum* Tehon, but it is only a weak parasite on jowar. It is capable of attacking young leave of bajra to some extent. Another form is found on rice. All these are being studied in pure culture.

Other Scientific Departments.

Madras.—Blast of the rice plant caused by Piricularia oryzae was found in several other districts but nowhere epidemic on a large scale. On Eleusine coracana, however, a similar disease caused by a species of Piricularia caused serious damage in Coimbatore district, the value of the loss probably exceeding a lakh of rupees. This fungus has not hitherto been recorded on this crop. Species of Piricularia were also found on Setaria italica and on wheat. The results of many infection experiments show that a culture from any one of the four host plants, Oryza sativa, Eleusine coracana, Setaria italica and Panicum repens will affect its own host but not the other three and that all will infect wheat and barley. Infection experiments on other grasses have so far proved to be negative. In nature a case has been observed where a severely infected crop of maturing Eleusine coracana caused the infection of a young wheat crop.

Ephelis oryzae causing sporadic damage to the rice plant has not yet been got to cause infection artificially. An Ephelis has been found on Panicum Crusgalli and on P. stagninum and an Ephelis associated with a Balansia on P. distachyum and P. javanicum.

The bud rot of palmyra palm was considerably less in the Godavari and Kistna districts this year. During December and January after the rains, where hitherto a large number of deaths had occurred, there were very few diseased or dead trees apparent in the infected area though the staff had stopped the actual cutting operations in November and was concentrating on a publicity campaign before the introduction of the Pest Act in March. There is considerable hope of the disease being reduced to a small minimum. In Madura district grape vines were sprayed with Bordeaux mixture against mildew with profit. The vines were kept under observation for a year before work was started. The value of the sprayed crop was on the average eight times that of the previous year and in some of the unsprayed plots this year the produce was wholly destroyed.

Coconut palms in various localities were operated on for bleeding disease by excision of the diseased tissue and afterwards flaming and tarring the exposed surfaces. Further observation of these and of trees operated on in previous years showed that the treatment was effective.

Mysore.—Black rot of coffee [caused by Corticium Koleroga (Cooke) V. Hohnel]. Two alternate host plants have been found for this important fungus in the neighbourhood of Coffee estates. One of these belongs to the Rubiacoae, the other to the Oleaceae. The question of transfer of the disease

from one host plant to another is under investigation. A disease of the pods of Ricinus communis was observed for the first time. The fungus, a Sclerotinia, was obtained in pure culture. It appears to be identical with Sclerotinia ricini recently reported from America. A Pythium disease of Turmeric Cureuma longa apparently identical with Pythium Butleri recently described by L. S. Subramaniam as attacking Ginger, etc., is under investigation.

Bombay.—Experiments have shown that the tambera disease of potato is caused by a mite that could easily be controlled by sulphur treatment and that this mite causes the leaf-curl of the chilli plant. The black rot of potatoes ascribed in last year's report to Rhizoctonia has been found to be a heat effect. The tambera disease of citrus, hitherto thought to be scab, is also due to a mite. The standard and Dwarf strains of the American milo variety of *Andropogon sorghum* were found to be resistant to grain smut (Sphacelotheca Sorghi) but not to loose smut (Sphacelotheca cruenta). Mildew on Cumin ciminum has been completely controlled by spraying with Bordeaux mixture. The campaign against Koleroga disease of Arecanuts was continued and the branches of 20,000 trees were sprayed.

Bengal.—The control of ufra (Tylenchus angustus) on rice was continued by burning stubble and by observing the early varieties known as Digha Dhans that escaped the disease.

Central Provinces.—To check cotton wilt heating the soil has on occasion shown marked effect but the general results are said not to be very conclusive. A few strains of rust resistant wheats and wilt free cottons have been isolated.

Bihar and Orissa.—The fungus causing wilt of linseed was studied and considered to be Fusarium lini.

Indian Tea Association.—Mr. Tunstall, Mycologist to the Indian Tea Association gave special attention to Brown blight (Glomerella cingulata) and Grey blight (Pestalozzia Theae). The fructification of thread blight was observed and sent to Kew for identification. Spraying tests with lime sulphur, Bordeaux mixture, and Burgundy mixture were made in Darjeeling against blister blight (Exobasidium vexans). Plots of 200 badly blighted bushes were sprayed at intervals of a week and the blighted leaves were weighed to give a measure of the intensity of infection. The Burgundy mixture was much the most efficient.

AGRICULTURAL BACTERIOLOGY

BY

J. H. WALTON, M.A., B.Sc.,

Officiating Imperial Agricultural Bacteriologist.

WORK AT PUSA.

Soil Biology.

Nitrification.—Investigations of the nitrification of cowdung, cow urine, and sheep fold manure were carried out and a paper on the subject was read at the Indian Science Congress, Nagpur, 1920, by Mr. Joshi. In the case of cowdung it was found that when added in the fresh state, no nitrate accumulation took place, but when added after storing, under either aerobic or anaerobic conditions, about one-third of its nitrogen was converted into nitrate. The nitrogen of the urine was rapidly converted into nitrate in the soil. The inhibiting effect of excess of carbohydrate on nitrification was shown by the results obtained when straw was added with the dung or urine. The losses of nitrogen that take place during storage are being further investigated.

Observations of the effect of these manures on the crop yield of oats in pot culture showed the growth of the plant to correspond to the amount of nitrate formed in the nitrification tests, but where a bad physical condition was produced in the soil, the yield was smaller than that expected from consideration of the nitrate figures.

Oats were grown in both pots and plots to which roots, stems, and leaves or the whole plant of dhaincha and cowpea were added. The crops obtained corresponded to the nitrate formation obtained in the laboratory nitrification tests with these plants and their parts.

Study of the wide variations in the accumulation of nitrate during the decomposition of various oil cakes in Pusa soil tend to the conclusion that they are due to the differences in the relative proportions of carbohydrate and nitrogen in the cakes. The oil content had very slight influence on nitrification and the addition of such materials as cellulose, filter paper, sawdust, starch, cane sugar and glucose to cakes rich in nitrogen, retarded the accumulation of nitrate. Further, in the case of Mahua cake, no nitrate was found after eight weeks' incubation, except when the cake had previously been fermented.

The nitrogen content of soil under fallow and growing crops was studied. Bhth nitrate and organic nitrogen content of the cropped plots were lower toan those of fallow plots and the differences were greatest during the period of most active growth of the crop.

Biological Analysis of soils.—Biological analyses of soil from an abandoned coffee estate in Mysore were carried out.

Nitrogen fixation.—Experiments on the effect of the accumulated products of its metabolism on the nitrogen fixing power of Azotobacter are being carried out. So far it appears that these products appreciably lower the amount of nitrogen fixation.

Numerous colonies of actinomycetes have invariably been found growing on Ashby's Mannite Agar plates, inoculated with a dilute soil suspension. Twelve species were examined for nitrogen fixing power. Only minute gains were recorded, but as this group of organisms is one of the most abundant in soil, their accumulated effect may be of considerable importance, and further investigations of their activities are being taken up.

Seven soils, two from Pusa and five from Mysore, were examined for nitrogen fixation under anaerobic conditions. In liquid culture gains of up to 6·5 Mgms. nitrogen per gram dextrose were obtained. Sugarcane megasse has proved an admirable medium for the growth of nitrogen fixing organisms, and its nitrogen content after inoculation with mixed cultures of nitrogen fixing organisms rose from 0·27 per cent. to 1·3 per cent. in two months.

Indigo.

Owing to the short rainfall and backward condition of the plant no experiments in manufacture have been carried out since those mentioned in the last report.

Pure cultures of indican hydrolysing bacteria were maintained in the laboratory; the culture In 10, the most efficient, isolated three years ago, has lost none of its efficiency in that period.

Sterilisation of Water:

Investigations on this subject were continued, and supplies of the steriliser (E.C.) were manufactured for the weekly disinfection of the wells on the estate.

Two to three per cent. of available chlorine was found to be the maximum possible obtainable with economy of current consumption, and in higher concentrations stability rapidly diminished. 2·5 per cent. is the optimum aimed at for economy in production and stability of the product.

Stability tests showed that solutions of this strength could be made stable for six weeks at plains temperatures (30° C.) and for six months or more at hill stations (20°-22° C.).

Work in the Provinces.

Punjab.—The effects of green manuring of sandy and clay soils are being studied. It has been found that green manure gives better results in both types of soil than the addition of available nitrogen in artificial manure equal

to that added to the soil by green manure. By green manuring, the yield from a sandy soil on the limit of cultivation has been raised above that of fertile, heavy soil. Work on the correlation of nitrogen fixation with seasonal factors and cultural practice was continued. In the reports published up to date no obvious correlation was found between quantity of rainfall and extent of nitrogen fixation. Correlation between good cultivation and nitrogen fixation was supported by the results obtained on the Hansi and Lyallpur farms, but not by those of village cultivation at Kaithan, Hoshiarpur.

Madras.—Work has been done on fermentation, ammonification and nitrification of organic manures, and on the influence of fermenting organic matter on the solubility of mineral phosphates. The experiments, however, have not been completed.

Central Provinces.—Biological analyses of the Bhata soil were carried out. The poor growth of leguminous crops in the newly cultivated Bhata soil appears to be due to want of phosphoric acid and scanty formation of nodules. The growth is improved by application of cake and inoculation with nodule bacteria.

Work was also done on decomposition of organic and green manures under various conditions, but is not complete.

No work on bacteriology has been reported from any other province.

Indian Tea Association (Assam).—Biological analyses of several acid soils were completed. Particular attention was paid to the influence of the variation of water-content, and the discovery of the optimum water content of each soil.

FORESTRY.

I.—SILVICULTURE

BY

S. H. HOWARD, B.A.,
Silviculturist.

Statistical work in typical forest crops.—The more accurate methods of measurement and the improved forms for recording, approved by the Board of Forestry in 1919, have been introduced in all measurements of crops this year. The conversion of the previous measurements, made by girth, into diameter measurements has taken up considerable time more especially as it was first necessary to find constants for converting the one to the other so as to eliminate the error introduced by the girth measurement. It appears that for sal (*Shorea robusta*) and *deodar* (*Cedrus Deodara*) to obtain the average of two diameters at right angles from a given measurement made by girth it is necessary to multiply by the constant ·3119 and to convert volumes measured over girth and calculated by the quarter girth formula into volumes from two diameters at right angles and calculated by the πr^2 formula, the quarter girth volume must be multiplied by the constant 1·2224 and not 1·2727—the ordinary conversion factor when the original measurements are made in an identical fashion, *i.e.*, either by diameters or by girths.

The introduction of the newer methods will, it is hoped, shorten considerably the time necessary for the production of reliable yield tables besides giving more accurate results. From measurements made this year on sal and deodar it is considered that measurements made by girths gave a resulting volume on the average about 4·5 % larger than that calculated from two diameters measured at right angles.

During the year 26 existing sample plots were remeasured and 7 new ones inaugurated by the Central Institute.

In addition to crop statistics Mr. Trevor has recently published single tree yield tables for deodar, kail and chir from measurements made in Kulu and a tentative single tree yield table for deodar and chir is shortly to be published in the new Chakrata Working plan compiled by the writer from measurements made in Jaunsar combined with the Kulu figures and Troup's figures in his monograph on Pinus longifolia.

The Sal (Shorea robusta).—The results to date of the Bengal taungya system, as applied to sal and other species are to be published shortly. The new method gives good promise of overcoming the difficulty of regenerating the fire protected Sal forests of Bengal, with their accompanying evergreen undergrowth, if a labour force of sufficient size can be kept on the work.

The problem of the regeneration of the sal in other provinces is not yet definitely solved though work continues at the Central Institute and in the United Provinces. Nothing definite can yet be said regarding natural reproduction. As regards artificial reproduction the chief difficulties in the United Provinces are lack of labour during the rains, the fact that rain often does not fall till a fortnight after the seed has ripened and that sal seed loses its germinating power very rapidly. The obvious solution, for those divisions where labour can be obtained in the rains, of raising the sal for the first few weeks in nurseries and then transplanting is unfortunately impracticable as the sal bears transplanting badly.

The writer has this year experimented in keeping sal seed a fortnight before sowing but during that time encouraging instead of preventing germination. So far the results are promising but it is too soon to draw definite conclusions.

A tentative single tree yield table for first quality Bengal sal has been worked out by the writer from measurements made in Bengal this year and is to be published shortly.

Afforestation.—The work in Zabarkhet Tappar had previously been done on a very small experimental scale. It is considered that the time has now come to attempt something rather larger.

Experiments to date had proved that weeding in the rains is very essential but any solution depending on this is unfortunately quite impracticable in many divisions as labour is unobtainable during the rains. Of all the experiments tried the only results which appear possible on a practical scale are—

(1) *Chir.* (*Pinus longifolia*)—sowings seem to thrive better unweeded than weeded. An acre has therefore been sown with chir half thoroughly ploughed up and weeded before the rains (when labour is available) and half ploughed in lines only. Though the chir is out of its habitat the object here is to get some crop on the ground as a start and it matters little what it is.

(2) *Sissoo.* (*Dalbergia Sissoo*)—sown in December on cleared ground appears to attain such a height before the rains start that it may persist with no weeding. Half an acre will therefore be sown next December.

(3) *Sissoo.*—Root and shoot cuttings put out in December are 3 feet in height before the rains and it appears highly probable that this height is sufficient for them to combat the subsequent grass growth. Three and a half acres will therefore be planted in this way next

December and the nursery has been increased in size to supply the necessary plants.

(4) *Bamboo.* (*Dendrocalamus strictus*).—Though seedlings have not been previously tried it appears probable that they may succeed. A quarter of an acre has been planted up.

(5) *Butea frondosa.*—One quarter of an acre has been sown as the tree often grows in these frosty localities.

A total of some $5\frac{1}{2}$ acres is now or will shortly be under experiment which should be large enough to draw some practical conclusions.

The Silvicultural Garden.—The usual experiments in germination, sowing and transplanting continue.

In addition experiments under Mr. Champion's direction connected with the twist in chir pine have been started.

Measurements to ascertain the season at which height growth takes place were started in December and after a complete year's record the results will be published. So far it may be said that in Dehra Dun the period December to middle of February is a period of rest for most species indigenous and exotic and for many till the end of March. A period of rapid height growth then commences and continues till July. What happens after that is not yet known.

The experiment in Camphor cultivation continues.

Developments in Silvicultural systems.—There is nothing particularly new to record this year. Several new working plans are in the course of compilation introducing or continuing one of the many variations of the uniform systems.

The only noteworthy change is a system for working sal forests in the United Provinces introduced by Mr. P. H. Clutterbuck, C.B.E., C.I.E., as a result of his extensive experience of this species. The method has been to be written up by Mr. E. A. Smythies in the *Indian Forester* and the chief points are that a volume yield for the forest is given and all fellings count against this whether final or intermediate. The marking proceeds over the forest in a definite direction up to this yield annually but the actual system of regeneration is immaterial. Thus where regeneration is lacking the marking may be little more than a thinning, where regeneration is profuse it may conceivably be a clear felling. At the same time over a certain definite portion of the forest special methods are undertaken to induce reproduction such as cleaning, sowing, etc., etc.

The great point of the system is that while it confesses our present comparative ignorance in the matter of natural reproduction of sal it takes advantage of the fact that whatever the reason may be there is, in point of fact, always enough reproduction already established somewhere or other in the forest to admit of adequate exploitation.

Miscellaneous.—It is pleasing to note that the fundamental importance of silviculture in forestry (it is after all the real basis of all forest management) is being recognised. The creation of a special circle for silvicultural research and working plans this year in the United Provinces must have very far-reaching results and already there are four provinces Burma, Bengal, Madras and the United Provinces, which have their own local silviculturists working at provincial problems.

FORESTRY.

II.—ECONOMIC FOREST PRODUCTS

BY

C. E. C. COX, I.F.S.,

Forest Economist.

The feature of the year's work has been the deputation in August 1919 of the Forest Economist, Mr. R. S. Pearson, to America and England with the object of reporting on the organization of forest research in the former country and of purchasing plant consisting of timber testing machines, seasoning plant, a saw mill and other modern fittings for the Economic Branch of the Research Institute. With a similar object Mr. Raitt, Cellulose Expert, proceeded to England in October 1919 with a view to purchasing an experimental pulp and paper making plant. During the year under report therefore the work of the Branch has consisted mainly in the purchase of new plant and fittings for the proposed extension of the Institute and work at Dehra Dun has been practically limited to the routine work of replying to enquiries regarding sources, outturn and prices of forest products. Field work has similarly been limited to an examination of the markets for turpentine and rosin throughout India, inspection of the timber seasoning experiments in South India and an investigation regarding possible developments of the trade and the outturn and prices of timber in South India and the Andamans.

1. **Observation and encouragement of the Paper Pulp Industry in India and Burma.**—During October 1919 Mr. Raitt proceeded on leave to England with the object of purchasing the requisite experimental pulp and paper making plants for the new workshops. With the erection of these plants it will be possible to carry out exhaustive experiments on the various kinds of bamboos, grasses and other raw materials which exist in India and Burma and which now await the results of such experiments for their development.

2. **Antiseptic treatment of Timber.**—The experimental creosoting plant was received from England during the year and is being erected. A fresh supply of 350 green sleepers of Spruce and Silver Fir has been obtained from the Punjab for the conduct of the first series of experiments and steps are now being taken to purchase an electric motor to facilitate the working of the plant.

3. **Physical and Mechanical Properties and Seasoning Powers of various Timbers.** (i) *Natural Seasoning.*—The detailed seasoning ex-

periments initiated last year have now been started at various centres in the Punjab, United Provinces, Assam, Bengal, Bihar and Orissa, the Central Provinces, Coorg and Madras, the records for which have been compiled, examined and put in order while the experiments were inspected in detail at two centres in Madras.

(ii) *Artificial Seasoning.*—This subject has been studied in detail by Mr. Pearson while on deputation in America and England with the result that the standard American and English experimental seasoning plants, *viz.*, a Tiemann and a Sturtevant plant, have been purchased and are expected shortly in India.

(iii) *Mechanical properties of timber.*—Since it has long been realised that the present timber testing machine in the Economist's workshop is quite inadequate, three of the latest standard pattern machines have been purchased in America and are now on their way to the Research Institute.

Detailed mechanical tests on *Eucalyptus globulus* and *Acacia Melanoxylon* from the Nilgiris and *Olea ferruginea* from the Punjab have been carried out during the year.

4. **Finding of markets and new uses for timbers including the issue of bulletins**.—Bulletins on the following timbers were completed during the year and are now in the press :—

1. *Bombax malabaricum.*
2. *Adina cordifolia.*
3. *Odina Wodier.*
4. *Lagerstroemia Flos Reginæ.*
5. *Dipterocarpus pilosus*, while that of
6. *Hopea odorata* is still under compilation in Burma.

5. **Gums, Resins and Oleo-Resins.**—The possibilities of an industry based on the tapping of Salai (*Boswellia serrata*) for its gum-oleo-resin as a source of turpentine continues to attract considerable attention. Bulk samples obtained from Khandesh were examined at the Indian Institute of Science, Bangalore and samples of the products have been forwarded to an interested Bombay firm for transmission to London for valuation. Tapping operations, commenced in Khandesh and the Gwalior and Kotah States, are now being extended to Bhopal and further developments depend upon the erection of a distillery at some suitable centre.

6. **Rosha Grass Oil**.—The subject of improved methods of distillation continues to elicit numerous enquiries. The question is being investigated on a commercial scale in the Central Provinces and Bombay and it is

understood that the possibility of increasing the outturn of grass in th Central Provinces is a question which is now engaging the attention of the local officers.

7. **Woods suitable for** (i) *Wood paving blocks.*—This subject is under observation in Bombay and the experimental pavements of Xylia blocks have been considerably extended.

(ii) *Bobbins, Shuttles and Picking sticks for Cotton and Jute Mills.*—Experiments on a commercial scale on various Indian timbers are at present being undertaken by the Utilization Circle of the United Provinces. The leading firm of bobbin manufacturers in England has been approached with a view to starting a branch business in India.

(iii) *Rifle Stocks.*—It having been found impossible to find any really suitable substitute for Walnut timber, operations are now being concentrated on the supplies of properly kiln-dried walnut half-wroughts to the Ishapore Rifle Factory from the North-West Frontier Province and from Kashmir.

(iv) *Three-ply.*—The manufacture of three-ply has now passed beyond the experimental stage in Assam where ply boxes for tea are now being manufactured from a wide variety of timber species. Difficulties have, however, lately been encountered in the matter of a tendency to ' cheesiness ' in certain timbers when used for this purpose. This matter is one of vital importance to the industry and the possible solution of the difficulty is now being made a subject for detailed investigation. The possibilities of three-ply for tea and rubber boxes are also being considered by several firms in South India as it is now becoming increasingly difficult to obtain adequate supplies of suitable timbers at a price which will permit of the ordinary box industry being run at a profit.

(v) *Cooperage.*—The general question is being investigated on a semi-commercial scale by the Utilization Circle, Bareilly. The problem of finding a suitable timber or timbers for cocoanut oil casks in South India in addition to White Cedar (*Dysoxylum spp.*) which is the only timber now being used for the purpose, remains to be solved. The subject was opened by Messrs. Tatas Ltd., who have erected a large Oil Mill at Ernakulam and intend to use imported Douglas Fir for the manufacture of oil casks, it being considered that this procedure is likely to prove more economical and satisfactory than that of depending upon a supply of the locally made casks. On the analogy that Douglas Fir has been found suitable for the purpose in the Phillipines and elsewhere sample casks and shooks of the chief Himalayan conifers have been supplied by the Utilization Circle, Bareilly and will be tested as soon as the Mill commences operations.

Steps have also been taken to purchase an experimental stave cutting and barrel making plant for the Economic workshops of the Research Institute so that there is every hope that a solution to the problem of a suitable timber for oil casks will be found reasonably soon.

8. **Charcoal Briquettes.**—An experimental briquetting press was purchased and erected during the year and the first series of experiments on charcoal dust with a binder of *Bauhinia retusa* gum have been carried out. The problem of an entirely suitable binding medium is as yet unsolved but valuable data on this subject have been collected during the Economist's tour in America which may be expected to indicate new lines for investigation.

ZOOLOGY.

I.—GENERAL ZOOLOGY AND PHYSICAL ANTHROPOLOGY

BY

N. ANNANDALE, D.Sc., F.A.S.B.,

Director, Zoological Survey of India.

Tours.—The following tours were undertaken by members of the department during the year :—

	Days.
To Madras from 1st to 3rd April 1919 by Dr. F. H. Gravely . .	3
„ Coonoor and Kotagiri from 1st to 15th April 1919 by Dr. N. Annandale	15
„ Bombay from 6th to the 19th July 1919 by Major R. B. Seymour Sewell	14
„ Barkuda Island, Chilka Lake, from 1st to 20th August 1919 by Dr. F. H. Gravely	20
„ Barkuda Island, Chilka Lake, from 10th to 20th August 1919 by Major R. B. Seymour Sewell	11
„ Barkuda Island, Chilka Lake, from 20th to 24th September 1919 by Dr. N. Annandale	5
„ Barkuda Island, Chilka Lake, from 3rd to 20th October 1919 by Dr. F. H. Gravely	18
„ Coonoor, Wynaad, etc., from 23rd September to 11th November 1919 by Major R. B. Seymour Sewell	50
„ Delhi from 22nd to 27th November 1919 by Dr. N. Annandale .	6
„ Nagpur from 10th to 18th January 1920 by Dr. F. H. Gravely .	9
„ Nagpur from 10th to 18th January 1920 by Dr. N. Annandale .	9
„ Nagpur from 11th to 18th January 1920 by Major R. B. Seymour Sewell	8
„ Manipur, Assam, from 14th February to 7th March 1920 by Dr. N. Annandale	23
TOTAL .	191

The most important of these tours was the tour in Manipur, Assam.

Staff.—Dr. F. H. Gravely vacated the post of Assistant Superintendent in January, 1920 on his appointment as Superintendent of the Government Museum, Madras. Dr. Baini Prashad was selected to succeed him as Assistant Superintendent in April, 1920. As Dr. Prashad was unable to assume his new appointment immediately, Mr. E. Brunetti was appointed to act temporarily in the interval.

Research.—Major R. B. Seymour Sewell, I.M.S., Officiating Superintendent, Zoological Survey of India, has completed a detailed account of

over fifty species of Indian cercariae, which has been submitted to the medical authorities for publication. The rest of the work of the department has been devoted mainly to the study of the freshwater molluscs and fish of various Indian localities.

Publications.—The following publications have been issued during the year :—

"Records of the Indian Museum," Vol. XVI, parts VI—VII.

"Records of the Indian Museum," Vol. XVIII, parts I—II.

"Records of the Indian Museum," Vol. XIX, Part I.

"Memoirs of the Indian Museum," Vol. VII, part III.

Library.—The addition to the library during the year number 1880. 853 books and periodicals were purchased, 855 received in exchange and the rest presented.

Collections.—The collections have on the whole remained in good condition, but owing to depletion of the staff it has been found very difficult to cope with their proper preservation.

Galleries.—For the same reason it has not been found possible to do anything in the public galleries except to maintain the old exhibits in good order.

ZOOLOGY.

II.—ECONOMIC ZOOLOGY.

Part I.—Agricultural Entomology

BY

T. BAINBRIGGE FLETCHER, R.N., F.L.S., F.E.S., F.Z.S.,

Imperial Entomologist.

It should be noted that, in compliance with orders of Government that the Report on Agricultural Entomology in India during the year ended 30th June 1920 should not exceed four pages exclusive of bibliography, only a very brief summary of the work done at Pusa and in the Provinces can be given here.

I.—Work at Pusa.

Insect Pests.—Numerous observations have been made and a fuller account of these will be found in the Scientific Report of the Pusa Research Institute for this year. The following abstract shows the main crops and insects dealt with :—

Cotton.—Experiments were continued to determine the relative immunity of cotton varieties against attack of insect pests. Work on Cotton Bollworms has been continued and other insect pests studied.

Rice.—Work on borer pests has been continued.

Sugarcane.—Work on borer pests of sugarcane and allied Gramineous plants was continued and several new borers were found during the year and our knowledge extended regarding those discovered in previous years.

Mulberry.—The mealy-bug, *Phenacoccus hirsutus*, Green, causing "Tukra" disease of mulberry has been further investigated.

Fruit-Pests.—Work was continued, especially on pests of apple and numerous new pests were discovered and observations made on them. The so-called Mosquito bug of tea (*Helopeltis theivora*) was found on apple at Shillong, sucking the shoots.

Lifehistories of Insects.—Besides the various insects mentioned above, about one hundred and fifty lots of insects, most of which had not been reared before, were bred out, their lifehistories investigated and figured as far as possible.

Grain Storage Experiments.—These have been extended to ascertain how far infestation occurs in the fields before harvest.

Bees, Silk and Lac.—The work was continued on previous lines.

Illustrations.—Coloured plates and black and white figures of numerous insects studied during the year were prepared.

Insect Survey.—Steady progress was made in additions to and arrangement and identification of the collection, which is now a large and important one and continues to expand at a rapid rate.

Catalogue of Indian Insects.—Work on this was pushed forward as far as possible.

II.—Work in the Provinces.

Madras.—Attention was chiefly concentrated on *Platyedra* (*Pectinophora*) *gossypiella* and in July 1919 the local Pest Act was put in force against this in the Coimbatore district, with most encouraging results.

The bionomics of *Pempheres affinis*, its seasonal occurrence and the attractiveness or otherwise of different strains of Cambodia cotton were studied.

Experiments on control of *Schoenobius bipunctifer* were in progress in the Kistna district.

Bombay.—Investigation of the Mango Fruit-fly was continued. *Pseudococcus sacchari*, a serious pest of sugarcane at Manjri, was also under observation. *Amsacta moorei sara* appeared as a bad pest of maize in the Panch Mahals district in 1919 ; at Dohad, of 1,254 moths attracted to light-traps 702 were egg-laden females. Borers (*Chilo simplex* and *Sesamia inferens*) did much damage, amounting to 47 per cent., to the *kharif juar* crop in the Surat district in September, and some work on natural control by parasites was done. Work on cotton pests was also done in Gujarat.

Central Provinces.—Work was done on pests of *Citrus*, on Cossid and Teragrid tree-borers and a survey of the distribution of cane-borers was commenced. *Diatraea auricilia*, *Emmalocera depressela*, *Scirpophaga xanthogastrella*, *Sesamia inferens* and *S. uniformis* were all found to bore cane in various districts, but *Chilo simplex* was found to be entirely absent from cane.

United Provinces.—No entomological work is reported.

Punjab.—The attack by Cotton Bollworms in 1919 was about normal and was estimated at 11·7 per cent. at Lyallpur and 5·2 per cent. in Ferozepur. Work was done on the lifehistory and utility of the Braconid parasite, *Microbracon*, of Cotton Bollworms, and Chalcidid egg-parasites of *Earias* were also bred. Maize, intersown with cotton as a trap-crop for *Myllocerus blandus*, gave good results. The lifehistory of *Euphalerus citri* was studied. Control work was done on *Idiocerus* on mango and *Chaetodacus cucurbitae*.

North-West Frontier Province,—Spraying of orchards has been continued with "Katakilla," which is found effective in checking Aphids on

peach trees. *Dacus oleae*, although present in wild olives at Cherat, has not yet been found to attack the cultivated olives at Peshawar.

Bihar and Orissa.—Work on parasites of *Agrotis ypsilon* was continued and the campaign against this pest was continued at Mokameh, 101,205 moths being caught, of which 43,325 were females. The damage done during the year was estimated at 436 *bighas*.

Bengal.—Further work on control of *Cryptorrhynchus gravis* was done. Control of *Hispa armigera* on rice at Chandshi (Barisal) was effected by means of bagging.

Assam.—Observations were made on the lifehistories of Dynastid and Melolonthid beetle-pests of sugarcane at Kamrup.

Burma.—Some work was done on the prevalence of *Schoenobius bipunctifer* as a pest of paddy and the mean reduction in the crop due to this insect was assessed at about 16 per cent.

III.—Native States.

Travancore.—Special study was made of *Nephantis serinopa*, a Xyloryctid pest of palms. The lifehistory and habits of a dipterous pest of ginger were studied. Campaigns against rice pests were carried out on a large scale.

Mysore.—Operations under the Pest Act were continued, as in the previous year, on *Kumblihula* work in Chitaldrug and Shimoga Districts. The indications are that the pest is being kept down to a negligible number in areas where work has been in progress for several years. The *kumblihula* work was extended to new areas in Kadur and Hassan Districts. Somewhat similar work on another species of *kumblihula* was taken up in villages of Kolar and Hassan Districts. Extensive experiments on the treatment of coffee trees on estates where Coffee Borer is bad are under way; preliminary results are promising. The following pests are also under investigation, and practical measures for control are under trial; sugarcane borer, Rice weevil, Mango hopper, Rhinoceros beetle on coconuts, castor semilooper and lime tree borer.

A beginning has been made in investigating the possibilities of Apiculture in Mysore.

Hyderabad.—No report has been received.

Kashmir.—Work has been done on control of fruit-pests and the lifehistories of the Cabbage Butterfly, Cutworm and Hairy Caterpillars were studied.

Baroda.—No scientific work is reported.

IV.—Other Entomological Work.

Indian Tea Association.—Attention was devoted mainly to investigation of Mosquito Blight (*Helopeltis theivora*). Experiments conducted on the

inoculation of affected tea-bushes with potassium salts were carried to a successful issue in 1919, and bushes which had apparently succumbed entirely to the attacks of the pest were completely cured and threw off the pest entirely, giving vigorous and heavy flushes although situated in the middle of an area completely shut up by this insect. From the beginning of 1920, the Chemical Branch has also given attention to the matter and it has been found that circumstances can obtain in the soil in which the potassium present is rendered unavailable for plants, thus supporting the theories of the Entomological Branch. Experiments are being conducted to endeavour to discover a practical means of dealing with this state of affairs.

South Indian Planting Districts.—No scientific work is reported.

ZOOLOGY.

II.—ECONOMIC ZOOLOGY.

Part II.—Forest Entomology

BY

C. F. C. BEESON,* M.A., I.F.S., F.E.S.,

Forest Zoologist.

Insects of the Sal.—Borers. (*a*) *Field work.*—Observations were continued in the 2 permanent incidence plots established in the borer attacked parts of Thano forest, Dehra Dun, and a third plot of 60 acres in the peripheral zone was surveyed and enumerated. Analyses of trees showing different degrees of attack were made to determine (*a*) the number of successful emergencies, proportion of failures due to parasitism, disease, etc., and (*b*) the conditions governing the survival of slightly attacked trees. The control measures devised in 1918 which were tested over an area of about 250 acres prove to be completely successful.

To determine the seasonal succession of sal borers and its connection with felling dates an experiment has been started in which 12 sal trees are felled one in each month throughout the year, and from each tree a log is removed monthly and caged.

(*b*) *Insectary work.*—Experimental rearing of larvæ from the prepupal stage in sealed tubes under varying conditions of moisture was continued with the object of determining the mortality due to parasitic fungi, bacteria, and diseases of unknown origin. The fungi were identified by Dr. E. J. Butler, Imperial Mycologist, who isolated a series of species of the genera *Acladium, Aspergillus, Botrytis, Cephalosporium, Dendryphium, Harpographium, Helminthosporium, Hormodendron, Penicillium, Stysanus* (Melauospora) and *Verticillium.*

The mixed nature of the fungus flora (which contains hyperparasites), and the variation in the morbid symptoms indicate that several factors cause the death of *Hoplocerambyx spinicornis* larvæ and that the prevalence of a specific parasitic fungus is less probable than was supposed.

* The writer was absent on leave for seven months of the year under review, during which period Messrs J. E. Macpherson, Personal Assistant to the President, Forest Research Institute and College, and F. M. Howlett, M.A., F.E.S., Imperial Pathological Entomologist held charge of this office.

Other Pests.—Insectary records have been obtained of pests of sal seed and the young seedling. The species primarily concerned are *Dichochrosis leptalis, Laspeyeresia pulverula* and Calandra sp.

Insects of the Teak.—An illustrated note on the Beehole borer of teak with suggestions for its control, has been prepared, and is now in the press as a Forest Record. No Field work was carried out by the Forest Zoologist's staff, but observations are being continued in sample plot areas by divisional officers.

Insects of the Toon.—The chalcidoid parasites of *Hypsipyla robusta* have been described by Capt. the Revd. Waterston, Bureau of Entomology, in a paper that will shortly appear as a Forest Record. Work has been started on the biology of the hymenopterous parasites and the predators of the caterpillars of this borer.

Lac.—A microscopic examination of the internal morphology of lac insects has been carried out under the direction of Mr. F. M. Howlett with the object of discriminating specific differences in the form of lac insect from different kinds of host tree.

Miscellaneous Pests.—During the year under report 186 consignments of specimens (including 1,362 insects) were received for investigation. In collaboration with the Forest Economist the borer fauna of timbers laid down under different methods of seasoning is being worked out. A total number of 2,614 pieces of timber has been received from divisions in which season experiments are in progress and from this material, numerous species of borers (amounting to some 7,000 specimens) have been bred out, adding considerably to our information on the food trees and distribution of timber pests. The more important of the new records are :—*Aeolesthes holosericea*, Fab. ex *Drimycarpus racemosus* ; *Batocera titana, Th.* ex *Sterculia villosa* ; *Ceresium* leucosticticum, White ex *Anogeissus latifolia* and *Grewia tiliaefolia* ; *Coptops aedificator*, ex *Aegle Marmelos, Careya arborea* and *Hololepta integrifolia* ; *Dialeges pauper*, ex *Cassia fistula* ; *Diorthus cinereus*, Fab. ex *Hardwicia binata* ; *Epipedocera affinis*, Chevr. ex *Grewia tiliaefolia* ; *Gnatholea simplex*, Gah. ex *Hardwickia binata* ; *Margites modicus*, Gah. ex *Anogeissus acuminata* and *A. latifloia* ; *Nyphasia apicalis*, Gah. ex*Anogeissus acuminata* ; *Plocaederus ferrugineus*, Linn. ex *Boswellia serrata* and *Hardwickia binata* ; *Xylotrechus quadripes*, Chevr, ex *Hymenodictyum excelsum* ; *Xylotrechus renominatus*, Beeson ex *Shorea robusta* and *Amoora Rohituka* ; *Xylotrechus semi*, L. et. G. ex *Careya arborea* ; *Xystrocera globosa*, Oliv. ex *Accacia modesta Platypus solidus*, Wat. ex *Acrocarpus fraxinifolia.*

Insect Collections.—Small batches of insets have been identified and returned by the following specialists :—*Siricidae* and *Tenthredinidae* by Dr. S. A. Rohwer ; *Syrphidae Stratiomyidae* and other Diptera by Mr. E. Brunetti ; *Asilidae* by Miss G. Ricardo ; *Odonata* by Major Fraser ; *Apidae* by the Government Entomologist, Madras ; *Microlepidoptera* by Mr. E. Meyrick ; *Carabidae* by Mr. H. E. Andrewes ; *Bostrychidae* by Mr. M. P. Lesne ; *Tenebrionidae*

by Mr. K. Blair; *Lamellicornia* by Mr. G. Arrow; *Curculionidae* by Dr. G. Marshall; *Scolytidae* and *Platypodidae* by Col. Winn-Sampson; *Cerambycidae* and *Lamiidae* by Dr. G. Gahan. While on leave the writer visited specialists in England and France and distributed 5,000 specimens of Cole optera and Hymenoptera.

Museum.—The principal additions to the museum comprise 529 specimens of timber showing the work of borers, skins of palm squirrels, bats, bamboo rats, etc. A consignment of 86 specimens of damage by borers to the principal Indian Forest trees was presented to the School of Forestry, Oxford.

Staff.—Consequent on the sanction by the Secretary of State for the recruitment of four forest entomologists, arrangements were made for the post-graduate training of I. F. S. probationers in entomology. The new post of Systematic Entomologist has been filled by the appointment of Surgeon Commander M. Cameron, M. B. R. N.

The writer was deputed to attend the Imperial Conference of Entomology held in London, June 1920, as the representative of the Government of India.

VETERINARY SCIENCE

BY

W. A. POOL, M.R.C.V.S.,

Offg. Director and First Bacteriologist Muktesar.

As mentioned in the two previous years reports, shortness of staff, enhanced demand for the products of this Laboratory, increased routine and administrative duties and paucity of labour, fodder, etc., have immensely contributed to reducing the amount of time that could be devoted to research work.

Rinderpest and Haemorrhagic Septicaemia.—The same experiments which were in hand during the year 1918-19 regarding infectivity of hides of both of these diseases were continued during the year under report.

Johne's Disease.—A herd infected with Johne's disease in Bettiah Raj in Bihar was submitted to a test with avian tuberculin. As it was impossible to obtain permission to kill any of the reacting animals, the value of the test could not be determined.

Tuberculosis.—The experiments foreshadowed in last year's report have been completed and an account of them will be published shortly.

Bovine Lymphangitis.—With material received from the Madras Presidency experimental work has been carried out and the causal organism has been isolated.

Surra.—An experiment was initiated on the recommendation of the Surra Committee to ascertain the effects on different animals of the inoculation of strains of the Trypanosoma evansi derived from other species.

Some experiments in curative drug treatment were carried out.

Publications.—An account of Syngamus Laryngeus in Cattle and Buffaloes ; Virulence of Tubercle bacilli islotated from bovine lesions in India and on Bovine lymphangitis was submitted for publication.

Reports from Veterinary Colleges and Provincial Laboratories.—No scientific work of any particular interest was carried out by the Veterinary Colleges or the Provincial Superintendents of the Civil Veterinary Department. Mr. Cross, the Camel Specialist, in his Annual Report for 1919-20 states that detailed reports on the course that Surra runs in the camel and also that camel surra runs in ponies and other animals are being published as Pusa Bulletins.

He further mentions the following investigations worthy of record :—

(*a*) Further experiments with tartar emetic in connection with treatment of Surra in camels.

(*b*) The treatment of Surra by other drugs.

MEDICAL RESEARCH

BY

The HON'BLE MAJOR-GENERAL W. R. EDWARDS, C.B., C.M.G., M.D., K.H.B., I.M.S.,

Director-General, Indian Medical Service.

The following is an extract from the report of the Scientific Advisory Board of the Indian Research Fund Association for 1919-20.

Plague.—The inquiry into plague preventive measures at Poona continued under Dr. Chitre till November 1919. The Bombay Government have sanctioned field experiments on a large scale in Belgaum and Dharwar which are now proceeding. The practical application of the results obtained by Major J. C. G. Kunhardt, I.M.S., and Dr. Chitre after some years of laboratory investigation will be awaited with much interest.

Hookworm disease.—This inquiry is proceeding in Trichinopoly under Dr. Mhaskar. That officer has been attempting to estimate the effect of jail life on the natural elimination of Hookworm ova in convicts. In conjunction with Revd. Father Caius he has been investigating the chemical composition of various anthelmintics and comparing their safety and comparative efficacy. Various papers have been published.

Entomology.—Mr. Awati has published three papers on the bionomics of house flies in a recent Number of the Indian Journal of Medical Research and two more papers are in course of publication. Mr. Awati has recently been deputed to Assam to assist in the Kala-Azar Survey. He will attempt to estimate the relative frequency of various biting insects in infected and non-infected areas.

The Research Fund Association have also granted a sum of Rs. 5,000 to Major W. S. Patton, Pasteur Institute, Coonoor, for the purpose of carrying out researches on entomology and protozoology. That officer has submitted various papers which will be published early in the Indian Journal of Medical Research, on Arthopods of medical and veterinary importance in Mesopotamia and a Study on Flagellates of the Genera Herpetomonas Crithidia and Rhynchoidomonas.

Kala-Azar.—Efforts were made to obtain an officer of the Bacteriological Department to be placed in charge of the whole of the Kala-Azar Inquiry in Assam, but owing to the shortage of the officers available for civil duty it has been found impossible to obtain one. Meanwhile Mrs. Adie continues to work at the development of the parasite causing Kala-Azar during its residence in the body of the bed bug.

Leprosy.—Dr. Sudhamoy Ghosh continues his work, under the general supervision of Major Knowles. A valuable report has been received from him which will be published in an early Number of the Journal.

The Fund has also given a grant to Dr. K. K. Chatterji for the purpose of experimenting with Neem or Margosa oil and its derivatives in the treatment of Leprosy. The Calcutta School of Tropical Medicine has joined with the Indian Research Fund Association in financing a large inquiry into special methods of treatment of this disease. This research will commence during the ensuing cold weather under Dr. E. Muir.

Deficiency Diseases.—The inquiry has ceased in India. Ten Sections of a paper on this subject have been published in the Journal by Lieutenant-Colonel McCarrison. The inquiry will reopen in England under that officer, at an early date it is hoped.

Malaria.—A report is in press from Lieutenant-Colonel Donovan detailing the result of his investigations into Malarial carriers (other than human)—a research conducted in the Nilgiri Hills during the months of May and June 1919.

Influenza Inquiry.—(*a*) Captain Malone is continuing his work on the bacteriology of the disease in Bombay. Three papers have been published in the Journal on this subject. He also published a paper on Encephalitis lethargica in Karachi. This is the first known appearance of this disease in India.

(*b*) An inquiry into the epidemiology of influenza was commenced in September 1919 by Major J. Morison, I.M.S. On his departure to England in April 1920, the inquiry was placed under Captain H. H. King, I.M.S. The questions which are being investigated refer to the rise, progress, and ending of individual epidemics and questions of the immunity conferred by previous attacks of the disease and by inoculation with vaccine. Very numerous reports received from all over India including Burma on the progress of the 1918 epidemic, in reply to a list of questions drawn up by the Office International D'Hygiene Publique, are under consideration.

Mollusc Survey.—This work conducted entirely by the members of the Zoological Survey under Dr. Annandale continued. A paper by Dr. Annandale and Captain Sewell on the subject will be published in an early number of the Journal.

Investigations in Karachi.—These ceased in January 1920 owing to the approaching demobilization of Captain Maitra's Hospital. A paper by Captain Maitra on "Observations on the cultural methods of Gonococcus" was published in the Journal.

Biochemistry.—Mrs. D. Norris' researches terminated on the 2nd November 1919. A paper by her on "The preparation of a simplified culture media for field workers" was published in the Journal.

LIST OF PUBLICATIONS.

Agricultural Chemistry.

AIYER, A. R. PADMANABHA, AND BAL, D. V.	The Chemical and Biological aspect of Bhatta soil of Chandkhuri Experimental Farm, Central Provinces. (*Read at the 7th Indian Scientific Congress, January, 1920.*)
AMIN, B. M. . . .	An improved method of preparing indican from indigo-yielding plants. (*Indigo publication No. 5.*)
ANNETT, H. E. . . .	Environmental factor influencing the alkaloidal content and yield of latex from the opium poppy (*Papaver somniferum*) and the bearing of the results on the function of alkaloids in plant life. (*Memoirs of the Department of Agriculture in India, Chemical series, in the press.*)
ANNETT, H. E. .	Factors influencing alkaloidal production in opium and the bearing of the results on the function of alkaloids in plant life. (*Communicated to the Biochemical Journal.*)
ANNETT, H. E. AND SEN, H. D.	The estimation of codein. (*communicated to the Analyst.*)
ANNETT, H. E., SEN, H. D. AND SINGH, H. D.	Non-environmental factors influencing alkaloidal content and yield of latex from the opium poppy. (*Papaver somniferum*), (*Memoirs of the Department of Agriculture in India, Chemical series in the press.*)
ANNETT, H. E., SEN, H. D. AND SINGH, H. D.	A survey of the Indian Opium growing districts for morphine content of the opium produced. (*Agricultural Research Institute, Pusa Bulletin, in the press.*)
ANNETT, H. E. AND SEN, J.	The use of poppy seed cake as a cattle food and its effect on yield of milk and composition of the butter fat. (*Journal of Agricultural Science, Vol. IX, part iv, October, 1919.*)
AYYAR, P. A. SUBRAMMANYA.	The gases of swamp rice soil, V. A. methane oxidising Bacterium from rice soils. (*Memoirs of the Department of Agriculture in India, Chemical series, Vol. V, part viii, in the press.*)

Clarke, G., Naib Hussain, and Banerji, S. C.	Notes on improved method of cane cultivation.
Gangolli, D. M. and Meldrum, A. N.	Indian Casein, part I, Preparation of "sulphuric" casein. (*Department of Industries, Bombay, Bulletin No. 1.*)
Ghosh, M. N. . .	A neglected source of sugar in Bihar. (*Agricultural Journal of India, Vol. XV, part i.*)
Harrison, W. H. . .	The gases of swamp rice soil, VI-Carbon dioxide and hydrogen in relation to rice soils. (*Memoirs of the Department of Agriculture, Chemical series, Vol. V, No. viii, in the press.*)
Harrison, W. H. and Das, S.	The retention of soluble phosphates in calcareous and non-calcareous soils. (*Memoirs of the Department of Agriculture in India, Chemical series, Vol.V, part ix, in the press.*)
Harrison, W. H. and Sanyal, P. B.	Effect of windrowing on the composition of sugarcane. (*Memoirs of the Department of Agriculture in India, Chemical series, in the press.*)
Leake, H. M. and Annett, H. E.	Investigations concerning the production of Indian opium for medical purposes. (*Agricultural Journal of India, Vol. XV, part ii.*)
Mukherji, J. N. . .	The excretion of toxins from the roots of plants. (*Agricultural Journal of India, Vol. XV, part v.*)
Plymen, F. J. and Aiyer, A. R. Padmanabha.	Variations in some characteristics of the fat and of buffalo and cow milk with changes in season and feeding. (*Read at the 7th Indian Science Congress, 1920.*)
Taylor, C. Somers .	The presence of aconitic acid in sugarcane juice and a new reaction for the detection of the acid. (*Transactions of the Chemical society, 1919, Vol. CXV.*)
Tamhane, V. A. . .	Probable effect of the proposed Sukkur Barrage Scheme on the development of salt land in Sind. (*Bulletin of the Bombay Agricultural Department, in the press.*)

Astronomy.

Evershed, J. . . .	Is Venus cloud covered? ("*Nature*," *104*, *675*.)
,, . .	The Magnetic storm of August 11th—12th, 1919. ("*Nature*," *104*, *436*.)

EVERSHED . . . . The Pulsation theory of Cepheid Variables. (*"Observatory," 42, 124.*)

" . . . The Moon in Daylight. (*"Observatory," 42, 339.*)

Meteorology.

SIMPSON, G. C. . . . British Antarctic Expedition, 1910-1913, Meteorology, Vol. I, Discussion; Vol. II, Charts. (*Thacker, Spink & Co., Calcutta, 1919.*)

NORMAND, C. W. B. . Meteorological conditions affecting Aviation in Mesopotamia. (*Q. J. R. Meteor. Soc., Vol. 45, 1919, p. 368.*)

" " . The effect of high temperature, humidity and wind on the human body. (*Q. J. R. Meteor. Soc., Vol. 46, p. 1.*)

A complete bibliography of meteorological papers published during the year will be found in the Journal of the Royal Meteorological Society and in the American Monthly Weather Review.

Botanical Survey.

ANNANDALE, N. AND CARTER, H. G. Notes on the Vegetation of Seistan. (*Journ. As. Soc., Bengal, Vol. xv, 1919, No. 6, pp. 267—297.*)

BLATTER, E., HALLBERG, P. F., AND McCANN, C. Contributions towards a flora of Baluchistan. (*Journ. Ind. Bot., Vol. i, No. 2, p. 54, No. 3, p. 84, No. 4, p. 128, No. 5, p. 169.*)

BLATTER, E. AND HALLBERG, F. The Flora of the Indian Desert (Jodhpur and Jaisalmer). (*Jour. Bom. Nat. His. Soc., Vol. xxvi, No. 2, p. 525, No. 3, p. 811, No. 4, p. 968.*)

" " The Flora of Persian Baluchistan and Makran. (*Vol. xxv., No. 4.*)

BURNS, W. . . . Variation in Bombay Strigas. (*Jour. Ind. Bot., Vol. i, No. 6, p. 212.*)

DEBBARMAN, P. M. . A short note on the atrophic abortion of the inflorescence of the onion. (Allium cepa *L.*) (*Jour. Bom. Nat. His. Soc., Vol. xxvii, No. 1, 1920, p. 179.*)

DEMELLO, F. . . . Contribution to the study of the Indian Aspergilli. (*Jour. Ind. Bot., Vol. i, No. 5, p. 158.*)

DRUMMOND, J. R. . Miliusa and Saecopetalum. (*Jour. Ind. Bot., Vol. i, No. 5, p. 162.*)

EKAMBARAM, T. . .	Suspected parasitism in a moss. (*Jour. Ind. Bot., Vol. i, Nos. 6 and 7, p. 206.*)
FYSON, P. F. . .	*Heterocarpus* Wight in the Pulneys. (*Journ. Ind. Bot., Vol. i, No. 4, p. 125.*)
" " . .	The Indian species of *Eriocaulon.* (*Jour. Ind. Bot., Vol. i, No. 2, p. 49.*)
FYSON, P. F. AND BALASUBRAHMANYAM, M.	Note on the Oecology of *Spinifix squarrosus L.* (*Jour. Ind. Bot., Vol. i, No. 1, p. 19.*)
GAMBLE, J. S. . .	The Indian species of *Mimosa.* (*Kew Bull. No. 1, 1920, p. 1.*)
GHOSE, S. L. . .	The *Myxophyceae* of Lahore. (*Jour. Ind. Bot., Vol. i, No. 1, p. 8.*)
HOLE, R. S. . . .	Note on *Ixora Butterwickii Hole.* (*Indian Forest Records, Vol. vii, Part IV.*)
KASHYAP, S. R. . .	Abnormal number of needles in the spurs of *Pinus longifolia.* (*Jour. Ind. Bot., Vol. i, No. 4, p. 115.*)
" " . .	Note on the floating islands of Riwalsar. (*Jour. Ind. Bot., Vol. i, No. 8, p. 252.*)
" " . .	Distribution of Liverworts in the Western Himalayas. (*Jour. Ind. Bot., Vol. i, No. 5, p. 149.*)
KENOYER, L. A. . .	Dimorphic carpellate flowers of *Acalypha indica, L.* (*Jour. Ind. Bot., Vol. i, No. 1, p. 3.*)
McLEAN, R. C. . .	Studies in the Œcology of Tropical Rain Forest (Rio de Janeiro). (*Journal of Œcology vii, (1919), pp. 5—59.*)
" " . .	Studies in the Œcology of tropical rain forest, etc. (*Journal of Œcology, Vol. vii, No. 3, p. 121.*)
PRAIN, D. AND BURKILL, I. H.	*Dioscorea sativa.* (*Kew Bull. No. 9, 1919.*)
RANGACHARIAR, K. AND TADULINGAM, C.	A note on certain species of *Polygala.* (*Jour. Ind. Bot., Vol. i, No. 2, p. 44.*)
RAO, JIVANNA P. S. .	Note on the geotrophic curvature of the inflorescence in *Eichhornia speciosa.* (*Jour. Ind. Bot., Vol. i, No. 6, p. 217.*)
" " .	The formation of leaf bladders in *Eichhornia, speciosa.* (*Jour. Ind. Bot. l. c., p. 219.*)
" " .	An anomaly in floral biology. (*Jour. Bom. Nat His. Soc., Vol. xxvi, No. 4, 1920, p. 1049.*)

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Gyrophæna rufiventris, n. sp., p. 50, Galle, Kitulgalle, Dikoya ; *Diestota subopaca*, n. sp., p. 50, Balangoda ; *Neobrachida*, n. g., p. 51, type *castanea*, n. sp., p. 51, Bogawantalawa ; *Pseudobrachida*, n. g., pp. 51-52, type *nigriventris*, n. sp., p. 52, Ceylon ; *Tachychara*, n. g., pp. 52-53, type *discipennis*, n. sp., p. 53, Dikoya.]

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Stagetus denticornis, n. sp., pp. 242-243, fig., W. Almora. Xylophilidæ: *Xylophilus bulbifer*, pp. 243-244, W. Almora; *Cnopus pinicola*, p. 244, W. Almora: n. spp. Bruchidæ: *Bruchus cœruleus*, pp. 244-245, W. Almora; *B. maculipyga*, pp. 245-246, Dehra Dun; n. spp.]

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" " . On some Eastern Xylophilids (Coleoptera.) (*Ann. Mag. Nat. Hist. (9) v, 393-406; May 1920.*) [*Hylobænus fasciatus*, Pic., pp. 393-394, Galle, Tenasserim, Penang, Borneo; *H. varicornis*, Champ., p. 394, Siam, Tenasserim, Philippines; *Xylophilus albolineatus*, n. sp., pp. 404-405, Kodaikanal; *X. brunneomaculatus*, Pic., p. 405, W. Almora, Kasauli, Simla; *X. himalaicus*, n. sp., pp. 405-406, W. Almora; *X. varus*, n. sp., p. 406, Kodaikanal.]

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" " Descriptions and records of Bees, LXXXVII. (*Ann. Mag. Nat. Hist. (9) iv, 355-360.*) [*Bombus prshewalskii*, Moraw., p. 355, Gulmarg, China; *Anthophora confusa*, Sm., p. 356, Murree; *Megachile disjuncta*, Fb., p. 357, Madras, Bangalore, Kurnul; *M. aureobasis*, Ckll., p. 357, Bangalore, female descr.; *M. ramakrishnæ*, Ckll. p. 357, Bangalore, Devanakonda, Kurnul; *M. fletcheri*, n. sp., pp. 357-358, Bangalore; *Pasites indicus*, n. sp., pp. 358-359, Pusa; *Crocisa minuta*, Rad., p. 359, Chapra.]

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" " †Two interesting insects in Burmese amber. (*Entom, lii, 193-195, figs.; Sept. 1919.*) [Micropterygidæ. *Micropteryx pervetus*, n. sp., pp. 193-194, figs. 1 A.-F. Embiadæ; *Burmitembia*, n. g., p. 194, *B. venosa*, n. sp., p. 195, figs. 2. 3.]

" " †Insects in Burmese Amber. (*l. c. 241-243; Nov. 1919.*) [Aleyrodidæ: *Aleurodicus burmiticus*, n. sp., p. 241, fig. 1. Psocidæ: *Psylloneura ? perantiqua*, n. sp., pp. 241-242, fig. 2. Chironomidæ: *Johannsenomyia swinhoei*, n. sp., p. 243, fig. 3.]

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" " Descriptions of new species and genera of the Heteropterous Family Reduviidæ from British India. (*Ann. Mag. Nat. Hist. (9) iv, 71-79.*) [*Ploiariola scotti*. Dist., p. 71, Mysore ; *Stenolæmus hirtipes*, n. sp. p. 71, Mysore ; *Eugubinus intrudans*, Dist., p. 71, Mysore ; *Neoklugia*, pp. 71-72, n. g., *N. typica*, n. sp., p. 72, Mysore ; *Neothodelmus*, n. g., p. 72, *N. typicus*, p. 73, Mysore ; *Pasiropsis major*, p. 73, Mysore ; *Edocla annulata*, pp. 73-74, Nandidrug ; *Ectomocoris simulans*, p. 74, Mysore, Vizagapatam ; *E. melanopterus*, p. 74, Mysore ; *E. picturatus*, p. 74, Mysore ; *E. apicimaculatus*, p. 75, Yercaud ; *Sphedanolestes aurescens*, p. 75, Bangalore ; *S. aterrimus*, p. 75, Mysore ; n. spp.; *Endochus albomaculatus*, Stal., p. 75, Mysore ; *E. erectus*, Nilgiris, *E. campbelli*, *E. parvispinus*, Mysore, n. spp.; *Brassivola hystrix*, Dist., p. 77, Mysore ; *Isyndus modestus*, p. 77, n. sp., Mysore ; *Coranus militaris* p. 77, *C. vitellinus*, p. 78, Mysore, n. spp.; *Allæorhynchus notatus* p. 78, Mysore, *A. bicoloratus*, pp. 78-79, Nandidrug, n. spp.; *Phorticus varicolor*, n. sp., p. 79, Mysore ; *Lanca*, *Epidaus*, differences, p. 79.]

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DRACOTT, C. H. . Notes on the flying White Ant and Scorpions that feed on them. (*Bombay Nat. Hist. Soc. Journn. xxvi, 873-874 ; Oct. 1919.*)

DUPORT, L. . Raport à Monsieur le Président de la Chambre d'Agriculture du Tonkin et du Nord-Annam sur quelques nouvelles observations effectuées à la Station Entomologique de Cho-Ganh. (*Suppl. Bull. 122, Chambre d' Agric. Tonkin et Nord-Annam, No. 4, 10 pp.; April-May 1919.*) [Notes on *Xylotrechus quadripes.*]

DUTT, G. R. . Second Hundred Notes on Indian Insects. (*Pusa Res. Inst., Bull. 89, pp. 102, 58 figs.*) [Notes 105, 106.]

ELLIOT, E. A. . Two new Stephanidæ. (*Entom. lii, 162-163.*) [*Diastephanus bilineatus*, pp. 162-163, Pusa, Chapra ; *Parastephanellus scitus*, p. 163, Pusa ; n. spp.]

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FELT, E. P. . . New Indian Call Midges. (*Diptera*). (*Agric. Dept. Entl. Mem., Vol. vii, No. 1., pp. 1-11 ; June 1920.*)

FERRIS, G. F. . Notes on Coccidæ. VI. (*Canad, Entom. lii, 61-65, fig. 12 ; Mar. 1920.*) [*Lepidosaphes erythrinæ*, Rutherf., 1914, from Ceylon, is synonym of *L. hawaiiensis*, Mask. 1894.]

FLETCHER, T. BAINBRIGGE. Second Hundred Notes on Indian Insects. (*Pusa Res. Inst., Bull. 89, pp. 102, 58 figs.*) [Miscellaneous notes nos. 102-104, 107-113, 115-118, 121-128, 130-145, 147-150, 152-153, 157-158, 160-165, 167, 168, 170, 172, 173, 176, 178-180, 182-185, 187, 189, 190, 193, 197, 199, 200.]

" " Report of the Imperial Entomologist. (*Sci. Rep. Agric. Res. Inst. Pusa, 1918-19, pp. 66-103, tabs. 7-9.*)

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" " Notes on some new and other Indian Dragonflies. (*loc. cit. pp. 874-878 ; Oct. 1919.*) [*Hemianax ephippiger*, p. 874 ; *Orogomphus xantheptera* [error typogr. for *xanthoptera*], n. sp., pp. 874-875, fig., Madura District ; *Macrogomphus annulatus*, Selys, pp. 875-876, Madura District ; *Diplacodes parvula*, Rmbr., p. 876, N. W.

India. *Disparoneura fletcheri*, p. 876, Shillong; *Caconeura mackwoodi*, pp. 876-877, Diyatalawa (Ceylon); *C. canningi*, p. 877, Coonoor; *Enallagma assamica*, pp. 877-878, Shillong: n. spp.]

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" " Notes on Odonata collected in Seistan and Baluchistan in winter. (*Rec. Ind. Mus. xviii, 79-82, 2 figs.; Sept. 1919.*)

" " Descriptions of four new Indian Odonata. (*Rec. Ind. Mus. xvi, 451-455; Dec. 1919.*) [*Argiocnemis gravelyi*, p. 451, Saugor; *A. dyeri*, pp. 451-452, Hoshangabad Distr., Poona; n. spp. *Himalagrion*, n. g., pp. 452-453; *H. exclamationis*, pp. 453-454, Sitong, Darjiling Distr.; *Agriocnemis d'abreui*, pp. 454-455, Lamta, Balaghat Distr.: n. spp.]

" " Descriptions of new Indian Odonate larvæ and exuviæ. (*loc. cit. pp. 459-467, t. 32-37; Dec. 1919.*) [*Epophthalmia frontalis*, Selys, pp. 459-460, t. 32, f. 1, t. 34, f. 2; *Tholymis tillarga*, Fb., p. 460, t. 32, f. 2, t. 34, f. 1; *Tramea limbata*, pp. 460-461, t. 32, f. 3, t. 34, f. 3; *Macrogomphus annulatus*, Selys, pp. 461-462, t. 33, f. 3, t. 34, f. 4, 4*a*; *Cyclogomphus heterostylus*, Selys, p. 462, t. 33, f. 1, t. 34, f. 5, 5*a*; *C. verticalis*, Selys, p. 462; *C. minusculus*, Selys, pp. 462-463, t. 33, f. 2, t. 34, f. 6, 6*a*; *Onychogomphus lineatus* Selys, p. 463; *Matrona basilaris*, Selys, pp. 463-464, t. 35, f. 1, t. 37, f. 1; *Lestes* sp., p. 464, t. 35, f. 2, t. 37, s. 2, 2*a*; *Copera marginipes*, Ramb., pp. 464-465, t. 35, f. 3, t. 37, f. 6; *Calicnemis miniata*, Selys, p. 465, t. 36, f. 4, t. 37, f. 5; *Protosticta gravelyi*, Laidl., pp. 465-466, t. 35, f. 4, t. 37, f. 7; *Chloroneura quadrimaculata*, Ramb., p. 466, t. 36, f. 3, t. 37, f. 4; *Pseudagrion microcephalum*, Ramb., p. 467, t. 36, f. 2; *P. hypermelas*, Selys, p. 467, t. 36, f. 1, t. 37, f. 3.]

" " Notes on Indian Dragonflies. (*Rec. Ind. Mus. xix, 31-33; June 1920.*) [*Rhodischnura nursei*, Morton, dimorphic females descr., distribution; *Enallagma insula*, n. sp. pp. 32-33, Chilka Lake.]

" " Description of a Rhinocyphine larva from Shillong. (*Entl. Mem. Dept. Agric. Ind., vii, No. 2, pp. 13-14, tab. 1; June 1920.*) [*Rhinocypha ignipennis* larva descr.]

FROGGATT, W. W. The Black Banana Stem Weevil (*Cosmopolites sordidus*, Germ.). (*Agricl. Gaz. N. S. W., Nov. 1919, pp. 815-818, figs.*)

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,, ,, Notes on some Asiatic species of *Palingenia* (*Ephemeroptera.*) (*l. c. xviii, 137-143, t. 18-20 ; April 1920.*)

,, ,, . The female of the Cockroach *Alluaudella* (*l. c. xix, 17-18, ff.; Mar. 1920.*) [*A. himalayensis*, female descr.]

,, ,, AND PRASHAD B. A note on the marine invertebrate fauna of Chandipore, Orissa, with notes on Echiuroids. (*l. c. xvi, 395-402, f.; Oct. 1919.*) [Notes on *Cicindela biramosa*, Fb., and *C. quadrilineata*, Fb.]

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,, ,, . Notes on Indian Coccidæ of the subfamily Diaspidinæ with descriptions of new species. (*Rec. Ind. Mus. xvi, 433-449, t. 26-31 ; Dec. 1919.*) [*Chionaspis annandalei*, p. 434, t. 26, f. 2*a-c*, Paresnath, on *Deudrocalamus strictus ; C. caroli* pp. 434-435, t. 26, ff. 3*a-b*, Darjiling, on tea ; *C. chir*, pp. 435-436, t. 26, ff. 4*a-e*, t. 27, f. 5*f*, Almora, on Chir pine ; *C. gudalura*, p. 436, t. 27, f. 6*a, b*, Nilgiris, on bamboo ; *C. spiculata*, p. 437, t. 27, f. 7*a-d*, 8*e, f*, Periaghat, on bamboo ; *Aspidiotus pseudocamelliæ*, pp. 438-439, t. 28, f. 10, Bellary, on *Capparis stylosa* ; *A. tamarindi*, p. 439, t. 28 ff. 11*a, b*, Coimbatore, on tamarind ; *Aonidia indica* p. 440, t. 28, ff. 12*a, b*, Calcutta ; *A. tentaculata*, pp. 440-441, t. 29, ff. 13*a-d*, Quilon, on *Vateria*

indica; *Gymnaspis ficus*, pp. 441-442, t. 29, f. 14*a*, *b*, Kollegal, on *Ficus retusa*; *G. ramakrishnæ*, p. 442, t. 29, ff. 15*a f*, Courtallum, on *Hemigyrosa*; *Parlatoria artocarpi*, pp. 442-443, t. 29, f. 16, Periaghat, on jak; *P. papillosa*, pp. 443-444, t. 30, ff. 17*a-g*, Palghat, on jak; *P. vateriæ*, p. 444, t. 30, ff. 18*a-e*, Quilon, on *Vateria indica*; *Lepidosaphes meliæ*, pp. 445-446, t. 30, ff. 20*a-c*, Coimbatore, on *nîm*; *L. retrusus*, p. 446, t. 31, ff. 21, Dodabetta, on *Litsea whiteana*; *Fiorinia frontecontracta*, p. 447, t. 31, ff. 22*a-d*, Bombay, on *Garcinia indica*; *F. plana*, pp. 447-448, t. 31, ff. 23*a-b*, Coimbatore, on *Elæodendron glaucum*: *F. sapindi*, p. 448, Poona, on *Sapindus trifoliatus*; n. spp.]

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„ „ A list of Coccidæ affecting various genera of plants. (*Ann. Appl. Biol. v. 261-273.*) [Plant genera *Quercus* to *Zuccagnia*.]

GUNASEKARA, S. T. Report on the anti-malarial campaign at Kurunegala. (*Ind. Med. Gaz. liv, 471-472; Dec. 1919.*)

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„ „ Descriptions of new Pyralidæ of the Subfamilies Crambinæ and Siginæ. (*Ann. Mag. Nat. Hist. (9) iv, 53-68; Aug. 1919.*) [*Chilo rufulalis*, p. 58, Kinyua (Upper Burma); *C. submedianalis*, p. 58, Batticaloa; *C. gemininotalis*, p. 59, Cachar; *Eschata irrorata*, p. 61, Khasis; n. spp.]

„ Descriptions of new Pyralidæ of the Subfamilies Crambinæ and Siginæ. (*Ann. Mag. Nat. Hist. iv, 137-154; Sept. 1919.*) [*Surattha albicostalis*, pp. 138-139, Horsleykonda (Madras); *S. arenalis*, p. 139, Moghal Sarai; *Ancylolomia agraphella*, p. 144, Assam, Timor;

A. dives, p. 145, Belgaum; *Charltona rufalis*, p. 153, Nilgiris, Trivandrum; *C. endothermalis*, pp. 153-154, Belgaum; n. spp.]

HAMPSON, SIR G. F. . Descriptions of new Pyralidæ of the Subfamilies Crambinæ and Siginæ. (*Ann. Mag. Nat. Hist. (9) iv, 305-326; Nov. 1919.*) [*Crambus chionopepla*, p. 307. n.n. for *C. chionostola*, Hmpsn., *l.c.* (9) iii, 290 (*præocc.*). *Siga*, Hb. (1827) antedates *Schœnobius*, Dup. (1844), p. 307; *Topeutis*, Hb. (1827) antedates *Scirpophaga*, p. 319; *Topeutis flavidorsalis*, n. sp., p. 319, Bhutan; *T. brunnealis*, n. sp., p. 319, Upper Chindwin Distr. *Cirrhochrista bifurcalis*, n. sp., p. 325, Formosa, Khasis, Philippines, S. Celebes, New Guinea.]

" " . New Moths collected by Mons. A. Avinoff in W. Turkestan and Kashmir during his journeys in 1909-12. (*Trans. Ent. Soc., London, 1919, pp. 431-434; Jan. 1920.*) [Noctuidæ: Agrotinæ; *Euxoa dimorpha*, n. sp., pp. 431-432, Kashmir (12,000 ft.); *Feltia fuscifusa*, n. sp., p. 432, Kashmir (16,500 ft.); Hadeninæ: *Trichoclea elæochroa*, n. sp., pp. 432-433, Kashmir (10,000 ft.). Pyralidæ: Agroterinæ; *Pyrausta rubritinctalis*, n. sp., p. 434, Kashmir.]

" " On new genera and species of Lepidoptera Phalænæ with the characters of two new Families. (*Nov it. Zool. xxvi, 253-282; Jan. 1920.*) [Zygænidæ: *Phacusa nicobarica*, *pp.* 272-273, Nicobars; *Illiberis endocyanea*, p. 273, Assam; *Artona flaviciliata*, p. 273, Raitdong (Sikkim); *A. digitata*, pp. 273-274, Dawnat Hills (Tenasserim); *A. phæoxantha*, p. 274, Shevaroys; *Campylotes burmana*, p. 281, S. Khyen Hills; n. spp.]

" " Catalogue of the Lepidoptera Phalænæ in the British Museum. Supplement, Vol. II.

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" " . *Harpactor costalis*, Stal, preying on *Ceratina viridissima*, D. T. (*Bombay Nat. Hist. Soc. Journ. xxvi, 872, Oct. 1919.*)

" " . Early occurrence of the Painted Lady (*Vanessa cardui, L.*) in the Darbhanga District, Behar. (*Bombay Nat. Hist. Soc. Journ. xxvi, 1046 ; Jan. 1920.*)

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" " . Field Experiments with anti-*Tortrix* Fluids. (*Ceylon Dept. Agric. Bull. 46, pp. 23, 4 t., 2 f.; Nov. 1919.*)

" " . Legislation regarding Shot-hole Borer (*Xyleborus fornicatus*, Eichoff.). (*Trop. Agric. liv, 31-34 ; Jan. 1920.*)

JEANNEL, R. . Sur quelques Trechinæ (Coleoptera, Carabidæ) du British Museum. (*Ann. Mag. Nat. Hist. (9) v, 98-112 ; Jan. 1920.*) [*Trechus championi*, n. sp., pp. 109-110, Naini Tal, W. Almora, Gopaldhara, Sikkim.]

JHAVERI, T. N. . Swarming Caterpillars of Northern Gujarat. (*Agri. Journ. India xv, 181-184 ; Mar. 1920.*) [*Prodenia litura* and *Cirphis loreyi.*]

KASARGODE, RAMRAO S. The Sugarcane borer and its control (*Bombay Dept. Agric. Bull. 94, 1920.*) [*Diatræa auricilia.*]

KING, J. L. . . Notes on the Biology of the Carabid genera *Brachynus, Galerita* and *Chlænius*. (*Ann. Ent. Soc. Amer. xii, 382-388, t. 30-31 ; Dec. 1919.*)

LAIDLAW, F. F. . Description of a new species of the genus *Pseudophæa* (*Euphæa*, Selys) from Western India, with some remarks on the section *dispar* of the genus. (*Rec. Ind. Mus. xix, 23-27, fig.; Mar. 1920.*) [*Ps. fraseri*, n. sp., pp. 23-25, fig., Castle Rock.]

LANG, W. D. . Note on copulation and oviposition in the Dragonfly *Sympetrum striolatum*, Charpentier. (*Entom. liii, 2-5 ; Jan. 1920.*)

LEWIS, G. . . On the Taxonomy of the Histeridæ. (*Ent. Mo. Mag. lv, 173-174 ; Aug. 1919.*)

MACKENNA, J. . Report on the Progress of Agriculture in India for 1918-19. (Calcutta ; 1920 ; 186 pp.) [Entomology, pp. 70-78 ; Pathological Entomology, p. 78.]

MAHDIHASSAN, S. . The cultivation of Lac from a physiological standpoint (Hyderabad ; 26 pp.)

MALLOCK, H. R. A. Some points in Insect Mechanics. (*Proc. Zool. Soc. 1919, 111-116, 8 figs.; Sept. 1919.*)

MARLATT, C. L. . The Pink Bollworm. (*Monthly Bull. Calif. Dept. Agric. viii, 478-485 ; Aug. 1919.*)

MARSHALL, G. A. K. Some new injurious Weevils from Asia. (*Bull. Ent. Res. ix, 273-277, t. 17 ; July 1919.*) [*Dyscerus fletcheri*, pp. 274-275, tab. 17, fig. 1, Shillong, Almora ; *D. malignus*, pp. 275-276, t. 17, f. 4, Shillong ; *Alcides mali*, pp. 276-277, t. 17, f. 3, Shillong. n. spp.]

" " On the genus *Aorus*, Schh. (Coleoptera, Curculionidæ.) (*Ann. Mag. Nat. Hist. (9) iv, 338-343 ; Nov. 1919.*) [Key to species, pp. 339-340 ; *A. hearseyi, Pasc.*, pp. 340-341, Rangoon, Tharrawaddy.]

MAULIK, S. . . Chrysomelidæ (Hispinæ and Cassidinæ) (*Fauna of Brit. India, pp. xix, 439, 130 figs.; 1919.*)

" " . . A new *Chlamys* from Darjiling. (*Rec. Ind. Mus. xix, 19-21, 2 figs.; Mar. 1920.*) [*C. pashokensis*, n. sp., from Pashok : Chrysomelidæ.]

MEYRICK, E. . Exotic Microlepidoptera, Vol. II, part 8, pp. 225-256 (Aug. 1919), pt. 9, pp. 257-288, (Nov. 1919), pt. 10, pp. 289-320 ; Mar. 1920. [Numerous new Indian genera and species.]

MORLEY, C. . . On some Equatorial and other species and genera of African Ichneumoninæ contained in the Collection of the British Museum. (*Proc. Zool. Soc. 1919, 117-171 ; Sept. 1919.*) [*Xanthojoppa*, Cam., p. 128 ; *Hoplismenus*, Grav., perhaps syn. with *Acanthojoppa*, Cam., p. 134 ; *Hoplismenus ceylonicus*, Cam., is male of *Eupalamus* (*Melanichneumon*) *kandiensis*, Cam. p. 134 ; *Lagenesta monitor*, n. sp., pp. 144-145, Assam : *Leptothecus*, Cam., redescr., pp. 149-150,

Amblyteles negatorius, Fb.,=*Eristicus iridipennis*, Cam. (Cape Colony)=*Pompilus divisus*, Sm. (Kashmir, Nepal), p. 160; *Spilichneumon*, Thoms.=*Haliphera*, Cam. (1903)=*Eutanyacra*, Cam. (1903), p. 161; *Xenojoppa kali*, n. sp., pp. 162-163, Dehra Dun and probably Assam; *Heresiarchini*, list of genera, pp. 164-165; *Miojoppa*, Cam., redescr., p. 167; *Benecles*, Cam., redescr., p. 170.

MORTON, K. J. . Odonata from Mesopotamia. (*Ent. Mo. Mag. lv, 143-144; June 1919; l. c. 145-151; July 1919.*) [*Sympycna pædisca annulata*, Selys, pp. 145-146, also probably from Quetta; *Anax parthenope*, Latr., p. 150, Masharra, Amara; *Hemianax ephippiger*, Burm., Masharra, Amara.]

" " . Odonata from Mesopotamia. (*Ent. Mo. Mag. lv, 183-192, 192-193, 3 figs. and tab.; Aug., Sept. 1919.*) [*Orthetrum sabina*, Dru., p. 183, Amara, Baghdad; *O. tæniolatum*, Schn., p. 184, Ruz.; *Crocothemis*, pp. 184-186; *C. erythræa*, Brull., pp. 186-187, Amara, Quetta, Bokhara; *C. servilia*, Dru., pp. 187-189. Amara, Baghdad, Qurnah, Basra, Pusa, Deesa; *Sympetrum decoloratum*, Selys, pp. 190-191, Amara, Jebel Hamrin, Qurnah, Basra, Caucasus, Quetta; *S. striolatum*, Charp., p. 192, Jebel Hamarin; *S. fonscolombii*, Selys, p. 192, Amara; *Trithemis festiva*, Ramb., p. 194.]

" " . Odonata collected in North-Western Persia and Mesopotamia by Captain P. A. Buxton, R.A.M.C. (*Ent. Mo. Mag. lvi, 82-87; April 1920.*) [Several Indian spp. referred to.]

" " . Odonata collected in Mesopotamia by the late Major R. Brewitt-Taylor, R.A.M.C. (*Ann. Mag. Nat. Hist. (9) v, 293-303, t. 14; Mar. 1920.*)

MUIR, F. . . On the mechanism of the Male genital Tube in Coleoptera (*Trans. Ent. Soc., London, 1919, pp. 404-414, t. 21; Jan. 1920.*) [Structure of tube in *Rhynchophorus ferrugineus*.]

OLLENBACH, O. C. Occurrence of *Stictopthalma godfreyi*, Roths. (*Bombay Nat. Hist. Soc. Journ. xxvi, 867-688, fig.; Oct. 1919.*) [Recorded from Tavoy Distr.]

" " . Notes on the habits of butterflies, *Zeuxidia masoni* and *Xanthotænia busiris*. (*Bombay Nat. Hist. Soc. Journ. xxvi, 869-870; Oct. 1919.*) [Recorded from Tavoy.]

ORMISTON, W. . Notes on Ceylon Butterflies, Part II. (*Spolia Zeylan. xi, 126-188, t. 2-8 ; Oct. 1919.*)

PAIVA, C. A. . Rhynchota from the Garo Hills, Assam. (*Rec. Ind. Mus. xvi, 349-377, t. 34-361, July 1919.*) [*Chrysocoris garoensis*, pp. 350-351 ; *Exithemus similis*, p. 353 ; *Sastragala trilineata*, pp. 355-356, t, 34, f. 1 ; *Colpura sulcata*, pp. 357-358, t. 36, f. 1 ; *Dasynus relatus* p. 358 ; *Ninus turaensis*, pp. 359-360 ; *Nerthus kempi*, p. 360, t. 36, f. 2 ; *Microvelia lineatipes*, p. 362, t. 34, f. 2 ; *M. atromaculata* pp. 362-363, t. 34, f. 3 ; *Perittopus maculatus* pp. 363-364, t. 34, f. 4 ; *Metrocoropsis*, n. g., p. 365 ; *M. femorata*, p. 365, t. 34, f. 5 ; *Bagauda cavernicola*, p. 366, tab. 36, fig. 3 ; *Scadra castanea*, pp. 367-368, t. 35, f. 1 ; *Paralibavius*, n. g., p. 368 ; *P. singularis*, p. 368, t. 35, f. 2 ; *Ectrychotes relatus*, pp. 368-369, t. 35, f. 3 ; *Sycanus ? dubius*, pp. 369-370 ; *Gorpis annulatus*, p. 370, t. 36, f. 4 ; *Nabis assamensis*, p. 371, t. 34, f. 6 ; n. spp. from Garo Hills.]

PARSHLEY, H. M. . On the preparation of Hemiptera for the cabinet. (*Entl. News xxx, 223-227 ; Oct. 1919.*)

PIC, M. . . . Longicornes nouveaux de Chine. (*Bull. Soc. Ent. France 1920, pp. 117-119.*) [*Leptura impressicollis*, pp. 117-118, *Ipothalia bicoloripes*, p. 118, *Leontium touzalini*, pp. 118-119, *L. punctulatum*, p. 119 ; n. spp., Yunnan.]

PIERCE, W. DWIGHT. Studies of Weevils (Rhynchophora) with descriptions of new genera and species. (*Proc. U. S. Nat. Mus. li, 461-473 ; Dec. 1916.*) [Table of superfam. in *Phytophaga*, pp. 462-463.]

" " The comparative morphology of the Order Strepsiptera, together with records and descriptions of insects. (*Proc. U. S. Natl. Mus. liv, 391-501, map. 5 figs., t. 64-78 ; Sept. 1918.*) [Keys to families and genera.]

PILLAI, N. KUNJAN Coconut : the Wealth of Travancore. (*Agric. Journ. Ind. xiv, 608-628 ; July 1919.*) [Insect pests, p. 624.]

PILLAI, R. MADHAVAN. An attack of *Nephantis serinopa* on coconut palm in Travancore. (*Agric. Journ. Ind. xiv. 668-669, t. 19, 20 ; July 1919.*)

POULTON, E. B. . Female forms of *Papilio polytes* bred at Hongkong. (*Proc. Ent. Soc. London 1919, p. xxii ; Jan. 1920.*)

PROUT, L. B. . New species and forms in the Joicey Collection. (*Ann. Mag. Nat. Hist.* (9) *iv, 277-282 ; Oct. 1919.*) [Geometridæ : Hemitheinæ : *Thalassodes clarifimbria,* n. sp., pp. 278-279, Maskeliya, Hakgala : Sterrhinæ : *Scopula linearis f. alstoni,* form n., p. 279, Uva (500 ft.), Pundaluoya ; *Scopula subpartita,* n. sp., pp. 279-280, Khasis.]

" " . New Geometridæ. (*Novit. Zool. xxvii, 265-312 ; June 1920.*) [*Anisodes* (*Pisoraca*) *insitiva,* n. sp., pp. 275-276, Palnis, Nilgiris, Formosa ; *A.* (*P.*) *mesotoma,* n. sp., p. 276, Hainan, Lower Burma ; *Anisodes* (*Perixera*) *argentosa,* n. sp., pp. 278-279, Travancore, Khasis, Penang, Singapore, Borneo ; *Scopula ochricrinita,* n. sp., p. 287, Khasis ; *S. nitidissima,* n. sp., p. 289, Kashmir Valley, Kulu ; *S. flavifurfurata,* n. sp., pp. 290-291, Sabathu ; *S. coangulata,* n. sp., pp. 292-293, Khasis ; *S. campbelli,* n. sp. pp. 296-297, Palnis ; *Ptychopoda palniensis,* n. sp., p. 311, Palnis.]

QUAINTANCE, A. L. AND BAKER, A. C. A contribution to our knowledge of the White Flies of the subfamily Aleyrodinæ (Aleyrodidæ.) (*Proc. U. S. Nat. Mus. li, 335-445, ff. 1-10, t. 32-77 ; Jan. 1917.*) [*Aleurocanthus,* Q. and B., pp. 335-336 ; *A. bambusæ,* Peal, pp. 337-339, t. 32, ff. 1-9, Calcutta, on bamboo ; *A. citriperdus,* Q. and B., p. 342, India, Ceylon, Java, on orange ; *A. dissimilis,* n. sp., pp. 342-343, t. 34, ff. 1-9, Mudon (L. Burma), on unknown vine ; *A. longispinus,* n. sp., pp. 344-345, t. 35, ff. 1-6, Calcutta, Moulmein, on bamboo ; *A. mangiferæ,* n. sp., pp. 345-347, t. 36, ff. 1-9, Bombay, Saharanpur, Dehra Dun, on mango ; *A. nubilus,* Buckt., pp. 347-348, ff. 2, Backerganj, on betel ; *A. piperis,* Mask, pp. 348-349, t. 37, ff. 1-6, Ceylon, on *Piper nigrum ; A. spiniferus,* Quaint., pp. 351-352, t. 38, ff. 1-6, Java, on *Citrus* and rose ; *A. woglumi,* Ashby, p. 355, throughout Orient : *Aleurocybotus,* Q. and B., p. 356 ; *A. setiferus,* n. sp., p. 357, t. 40, f. 2, Peradeniya, Java, on grasses : *Aleurolobus,* Q. and B., pp. 357-358 ; *A. barodensis,* Mask., pp. 359-360, t. 41, ff. 1-11, Baroda, on sugarcane, *longicornis,* Zehnt., is synon ; *A. flavus,* n. sp., pp. 360-361, t. ff. 1-8, Peradeniya, on *Loranthus ; A. setigerus,* n. sp., pp. 372-373, t. 45, ff. 1-6, Peradeniya, on *Harpullia pendula ; A. simulus,* Peal, pp. 373-376, t. 46, ff. 1-14,

Calcutta, on *Bombax malabaricum* : *Aleuroplatus*, Q. and B., p. 381 ; *Aleuroplatus*, n. subg., pp. 382-383 ; *A.* (*A.*) *ficus-rugosæ*, n. sp., pp. 387-388, t. 49, ff. 13-16, Calcutta, on *Ficus rugosa* ; *A.* (*A.*) *incisus*, n. sp., pp. 388-389, t. 52, f. 2, t. 49, ff. 20, 21, Peradeniya, on *Ostodes* and *Garcinia* ; *A.* (*A.*) *pectiniferus*, n. sp., pp. 393-394, t. 53, ff. 10-14, t. 56, ff. 2, Lahore, on *Morus* ; *A.* (*A.*) *translucidus*, n. sp., pp. 397-398, t. 58, ff. 2, t. 60, ff. 8-14, Lahore, Wazirabad, on orange ; *Dialeurodes*, Ckll., key to subgenera, pp. 405-406 ; subg. *Dialeurodes*, key to species, pp. 406-408 ; *D.* (*D.*) *citri*, *Ashm.*, pp. 408-412, t. 63, ff. 1-14, t. 64, f. 1, America, India, on orange ; *D.* (*D.*) *radiipuncta*, n. sp., pp. 418-419, t. 66, ff. 5-7, Peradeniya, on *Memexylon* ; *Rusostigma*, n. subg., p. 420 ; *D.* (*R.*) *eugeniæ*, Mask., p. 421, t. 68, ff. 1-5, India, on *Eugenia jambolana* ; *Dialeuronomada*, n. subg., p. 424 ; *D.* (*D.*) *dissimilis*, n. sp., pp. 424-425, t. 70 ff. 1-4, Saharanpur, on *Phyllanthus myrtifolium* ; *Rabdostigma*, n. subg., p. 425 ; *D.* (*R.*) *radiilinealis*, n. sp., pp. 425-426, t. 70, ff. 5-8, Nuwara Eliya, on mistletoe ; *Rhachisphora*, n. subg., pp. 430-431 ; *D.* (*R.*) *trilobitoides*, n. sp., pp. 433-434, t. 75, ff. 6-11, t. 74, ff. 2, Peradeniya, on *Harpullia* and *Eugenia operculata* ; *D.* (*R.*) *rutherfordi*, n. sp., pp. 432-433, t. 75, ff. 1-5, t. 74, f. 1, Peradeniya, on *Loranthus* ; *Dialeuropora*, n. subg., p. 434 ; *D.* (*D.*) *decempuncta*, n. sp., pp. 434-435, t. 76, ff. 1-7, Peradeniya on cinnamon and Lahore on mulberry ; *Neomaskellia*, Q and B., pp. 436-437 ; *N. bergii*, Sign., pp. 437-439, t. 77, ff. 1-14, Java, Manila, on a wild grass.]

RAMACHANDRA RAO, Y. Second Hundred Notes on Indian Insects. (*Pusa Res. Inst., Bull. 89, pp. 102, 58 figs.*) [Notes 114, 129, 151, 159, 169, 181, 196.]

" " . Lantana Insects in India, being the report on an inquiry into the efficiency of indigenous insect pests as a check on the spread of *Lantana* in India. (*Agric. Dept., Entl. Mem. Vol. v, No. 6, pp. iii+239-314, tabs. 24-37, 3 figs.; June 1920.*)

RAMAKRISHNA AYYAR, T. V. Second Hundred Notes on Indian Insects. (*Pusa Res., Inst., Bull. 89, pp. 102, 58 figs.*) [Notes 119, 120, 146, 166, 171, 174, 177, 188, 192, 194, 195, 198.]

RAMAKRISHNA AYYAR, T. V. A contribution to our knowledge of South Indian Coccidæ. (*Pusa Bull. 87, pp. 1-50, figs. 1-40, tabs. 1-16.*)

" " . Records of Trigonalidæ from South India (*Rec. Ind. Mus. xvi, 471-474, fig.; Dec. 1919.*) [*Pœcilogonalos fulvoscutellata*, pp. 471-472, Palnis; *P. kerala*, pp. 472-474, fig., Malabar : n. spp.]

" " . Administration Report of the Government Entomologist for 1917-18. (*Rept. Madras Dept. Agric., pp, 74-77 ; 1918.*)

RICARDO, G. . Notes on the Asilidæ ; Subdivision Asilinæ. (*Ann. Mag. Nat. Hist, (9) v, 209-241 ; Mar. 1920.*) [Key to spp. from India, Burma and Cochin-China, p. 213 ; *Promachus duvaucelii*, Macq, p. 214, Dehra Dun ; *P. marcii*, Macq., pp. 214-215, Gundunri, Bhandani ; *P. binghamensis*, n. sp., pp. 215-216, Darjiling ; *P. heteropterus*, Macq., p. 216, Bellary Distr.; *P. calanus*, Wlk., pp. 216-217 ; *P. contractus*, Wlk., p. 217 ; *P. apivorus*, Wlk., pp. 217-218, Burma, Siam ; *P. maculatus*, Fb., p. 218, Trincomali, Colombo, Bangalore ; *P. pseudomaculatus*, n. sp., pp. 218-219, Nilaveli and Kuchavelli (Ceylon) ; *P. leoninus*, Loew., p. 219, S. Shan States, Sikkim ; *P. yerburiensis*, n. sp., p. 220, Trincomali, Guindy, Coimbatore.]

RILEY, N. C. . A new *Arhopala* (Lep. Lycænidæ) from Ceylon. (*Entom liii, 97-98 ; May 1920.*) [*Arhopala ormistoni*, n. sp., Nakiadeniya (Galle District.)]

ROHWER, S. A. . Three new species of Indian Drynnid parasites of Rice Leaf-hoppers. (*Proc. U. S. Natl. Mus. lvii, 159-161, tab. 22 ; 16 June 1920.*) [*Digonatopus lucidus*, p. 159, Pusa ; *Haplogonatopus orientalis*, pp. 159-160, Bilaspur ; *Pseudogonatopus sogatea*, pp. 160-161, Pusa : n. spp.]

ROTHSCHILD, LORD Preliminary descriptions of some new species and subspecies of Indo-Malayan Sphingidæ. (*Ann. Mag. Nat. Hist. (9) v, 479-482.*) [*Marumba scotti*, n. sp., pp. 480-481, Shillong, larva descr.; *Cechenena scotti*, n. sp., pp. 481-482, Masuri, larva descr.]

RUCKES, H. . . Notes on the male genital system in certain Lepidoptera. (*Ann. Ent. Soc. Amer. xii, 192-212, t. 10-12.*)

SAMPSON, WINN . Notes on Platypodidæ and Scolytidæ collected by Mr. G. E. Bryant and others. (*Ann. Mag. Nat. Hist. (9) iv, 105-114 ; Sept. 1919.*) [*Platypus solidus*,

Wlk., p. 106, Ceylon, India, Sunda Islands, Penang; *P. pilifrons*, Chap., p. 106, India, Indian Archip., Penang; *Xyleborus submarginatus*, Blandf., p. 109, India (Belgaum), Ceylon, Celebes, New Guinea, Sarawak; *X. comptus*, n. sp., p. 111, Ceylon, on *Hevea brasiliensis*; *X. undulatus*, n.sp., pp. 111-112, Bengal; *Phlœsinus jubatus*, n. sp., pp. 112-113, Dehra Dun; *Cryphalus corpulentus*, n. sp., pp. 113-114, Nilgiris.]

SCOTT, F. B. . The Hawk-moth (*Deilephila livornica*); a correction. (*Bombay Nat. Hist. Soc. Journ. xxvi, 872; Oct. 1919.*) [Sphingid recorded in this *Journal* Vol. xxv, part 1; was *Celerio euphorbiæ nervosa*.]

" " . Notes on the larva of the *Protoparce convolvuli*. (*Entom, lii, 166-167.*)

" " . Curious accident to Sphingid larvæ. (*Entom. lii, 262; Nov. 1919.*) [Captive larvæ of *Chœrocampa theylia* [perhaps *Hippotion boerhaviæ*] accidentally poisoned by naphthaline.]

SENIOR-WHITE, R. *Toxorhynchites minimus*, Theob. (*Spolia Zeylan. xi, 189-191; Oct. 1919.*) [Female descr.]

" " . On the occurrence of Coleoptera in the human intestine (*Ind. Jl. Med. Res. vii, 568-569, t. 55; June 1920.*) [*Onthophagus bifasciatus*, Fb., found in Ceylon.]

SMITH, K. M. . A comparative study of certain sense-organs in the antennæ and palpi of Diptera. (*Proc. Zool. Soc. 1919, 31-69, f. 43, t. 4; Sept. 1919.*)

SPEYER, E. R. . Recommendations for the control of Shot-hole Borer of Tea. (*Trop. Agric. liii, 36-37; July 1919.*)

" " . Shot-hole Borer. A control pruning scheme, and its practical modification. (*Ceylon Dept. Agric., Bull. 44, 8 pp.; June 1919.*)

STANTON, A. T. . The Mosquitos of Far Eastern Ports with special reference to the prevalence of *Stegomyia fasciata*, F., (*Bull. Entom. Res. x, 333-334; April 1920.*)

SUBRAMANIAM, T. V. A curious method of feeding noted in *Danais limniace*, Cram. (*Bombay Nat. Hist., Soc. Journ. xxvi, 1047; Jan. 1920.*)

SUSAINATHAN, P. . Second Hundred Notes on Indian Insects. (*Pusa Res. Inst., Bull, 89, pp. 102, 58 figs.*) [Note no. 175.]

SWAIN, A. F. . A Synopsis of the Aphididæ of California. (*Univ. Calif., Techn. Bull., Entom., iii. No. 1, pp. 1-221,*

t. 1-17; Nov. 1919.) [Containing references to many Indian genera and species and (pp. 154-158) a translation of van der Goot's key to genera and tribes.]

SWINHOE, C. . . Indo-Malayan and Australian Noctuidæ. (*Ann. Mag. Nat. Hist. (9) iv, 118-127; Sept. 1919.*) [Sarrothripinæ; *Characoma perfecta*, pp. 118-119, *C. araca*, p. 119, Khasis, n. spp.; *Giaura multipunctata*, p. 119, nom. nov. for *punctata*, Swinh. (1890) (præocc.), Tenasserim, Khasis, Nilgiris; *Barasa suffida*, n. sp., p. 120, Khasis; Odontodinæ: *Stictoptera anca*, n. sp., pp. 120-121, Khasis; *Gyrtona yucca*, Swinh, p. 121, Singapore, Perak, Andamans, Ceylon; *Lophoptera apirtha*, Swinh., p. 121, Simla, Sikkim, Khasis, Fort Stedman, Andamans; *L. hampsoni*, n. sp., p. 121, Nilgiris; Noctuinæ: *Simplicia moorei*, n. sp., p. 122, Ceylon; *Floccicura trilinea*, Beth-Baker, p. 122, New Guinea, Perak, Madras, Assam, Sikkim; *Plecoptera oculata*, Mo., p. 123, Khasis, Bombay; *P. quæsita*, Swinh, p. 123, Khasis, Bombay, Gujarat, Nilgiris, Burma, Andamans; *Oræsia argyrosigna*, Mo., p. 123, Ceylon, Nilgiris, Sikkim, Assam; *Attonda*, n. g., pp. 123-124, type *Capnodes trifasciata*, Mo.; *Hypospila andamana*, n. sp., pp. 124-125, Andamans, Nicobars; *Tochara creberrima*, Wlk., p. 125, Sylhet, Khasis, Perak, Andamans.]

" " . . On the geographical distribution of the genus *Anomis* Hubner (*Lineopalpa*, auctorum), a Noctuid of the Family Gonopteridæ. (*Ann. Mag. Nat. Hist. (9) v, 250-258 Mar. 1920.*) [*Anomis mesogona*, Wlk., p. 252, t. 9, f. 2; *A. involuta*, Wlk., p. 252, t. 9, f. 4, Ceylon, India to Simla; *A. fulvida*, Gn., pp. 252-253, 256, t. 10, f. 7, Assam, India, Malaysia, Borneo; *A. combinans*, Wlk., pp. 254-257, t. 11, f. 12, Ceylon, Borneo, Engano; *A. albitibia*, Wlk., pp. 254, 258, t. 12, f. 13, Ceylon, South India, Assam, Rangoon, Perak; *A. metaxantha* Wlk., pp. 254-255, 258, t. 12, ff. 15, Assam, Sikkim, Nilgiris, India generally; *A. involuta*, Wlk., p. 255, Siam, Yatung, Ceylon, Assam, Rangoon, Karachi, Simla, Bombay, Nilgiris.]

TILLYARD, R. J. . On the morphology and systematic position of the Family Micropterygidæ (sens. lat.). Introduction and Part 1 (the wings.) (*Proc. Linn. Soc. N. S. Wales. xliv, 95-136, 14 figs., 1 tab.; June 1919.*)

TILLYARD, R. J. . The Panorpoid Complex. Part 3, the wing-venation. (*Proc. Linn. Soc. N. S. Wales xliv, 533-718, ff. 35-112, t. 31-35 ; Dec. 1919.*)

TOMLIN, J. R.LEB. An Oriental Cucujid-beetle in Cheshire. (*Ent. Mo. Mag. lvi, 46 ; Feb. 1920.*) [*Læmotmetus rhizophagoides*, Wlk., found in bones. Known from Ceylon, Formosa, Sumatra, Borneo, Timor, Celebes, Ceram, New Guinea and British East Africa.]

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